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BRIEFLY TOLD.

THE GASHOLDER DISASTER.—The caption of this week, respecting that of last week, in the matter of the unfortunate gasholder tank lapse or collapse which happened in this city the evening of the 13th inst., may not be changed; for the mystery of its cause still remains unsolved. In the interim, several of the local scientific publications—such as *Engineering News*, *Scientific American* and *Iron Age*—have gone largely into the half-tone method of explaining by actual illustration how the smash occurred. We are prepared to admit that "seeing is believing," and that arriving at the actual truth is reached by other means than sight, but in this instance we fear that the pictures are valueless, in that they were made rather after than before or during the fall. The cold fact in this lamentable occurrence, and lamentable happening it surely was, is that certain simple rules in engineering practice will at last apply, and as it is the province of the law to eventually determine whether the Messrs. Logan or the Consolidated Gas Company were at fault, it would appear that the interests of each would be best conserved were opinion over the disaster withheld until the matter has been decided by the responsible tribunal. Meanwhile it is to be regretted that one high in authority in the financial management of the Consolidated Gas Company was so quick in asserting that, as the holder had not been accepted, the loss attending its collapse would not fall upon the Company. He who travels slowly travels safely; and he who travels safely travels far—so goes the Italian proverb—which proverb might in this case be amended to read that he who travels alone is like the client that practices law on his own account to save himself the fee that should go to one versed in the law. A coroner will hear testimony in the case this week, and the belief current now is that the coroner's quest may be productive of something worth recording from an engineering point of view.

THE SMASH AT POUGHKEEPSIE, N. Y.—The echoes of the collapse of the Consolidated Gas Company's holder were little more than ended when the news was bruited in New York city that (fortunately the report emanated or was sent from some press agency) the works of the Poughkeepsie (N. Y.) Gas Light Company had been destroyed. It is unfortunately true that the explosion of the Company's purifying house (which explosion occurred late the afternoon of Friday, the 16th inst.), caused eventually the loss of three lives, the temporary wrecking of the Company's largest holder, and some damage to the properties of the residents of the city (chiefly from the smashing of window panes), but it is nevertheless true that the Company was sending out gas from its generating sets 24 hours after the explosion occurred. The trouble at Poughkeepsie seems to be chargeable to the carelessness of one of the responsible workmen who (he paid for his mistake with his life) neglected to pay attention to the valves at a time when such attention was most needed—the accident happened right as the men were changing from day to night shift. The holder at Bayeux street (formerly the site of the Poughkeepsie Company's old coal gas plant) acted very much like a safe anchor in the Company's troublous times. This case, too, will be reported in the JOURNAL when the responsibility for the happening has been properly placed by authority.

THE LOUISVILLE GAS COMPANY'S APPEAL IS SUSTAINED.—The Court of Appeals of Kentucky has reversed the decision of the lower courts, in the matter of the award by the latter of $250,000 to Messrs. Kaufman, Straus & Co., for the destruction of their drygoods shop and its contents by an alleged contributory act of the Louisville Gas Company. On the evening of October 26, 1891, a boiler of the Louisville Electric Light Company (for such is the record) exploded, the heat following the explosion setting fire to the shops of Kaufman, Straus & Co., which shops and their contents were thus destroyed. In due time the concern of Kaufman, Straus & Co., collected their insurance, which amounted to $195,500, and later on, following the instinct which prompts people of their nationality to do twice for themselves, they instituted a suit in the first court against the Louisville Gas Company and the Louisville Electric Light Company, to recover in their own right and on behalf of the insurance companies, the aggregate sum of $242,557; it being agreed all round that the Gas Company was the operating owner of the electric company at the time of the explosion. The first court held that the explosion was the result of "low water" in the electric concern's boilers, and that as the Gas Company was the real owner of the boilers, etc., it should and must be held responsible for the damage. The judgment under the ruling amounted to $231,000; of which sum $219,000 was apportioned to the "suffering" insurance companies. The Gas Company appealed with pleas sufficient before the Court of Appeals to overturn the under ruling, as above stated, and now the Messrs. Kaufman & Straus Company and their impleaded insurance allies will have the satisfaction and pleasure of dividing the costs of the action between them. This ruling or decision means much to the Louisville Gas Company, whose managers will in the near future give the Kentucky Heating Company an opportunity to demonstrate whether "natural" gas or artificial gas is the fitter to survive.

DEATH OF DR. SCHANCK.—"I regret to report the death of Dr. J. Stillwell Schanck, who served Princeton (N. J.) University capably and faithfully as Professor of Chemistry, for near a-half century—since 1856. A graduate of Princeton (class of 1840), his mental tutor called him to her service in 1847, as instructor in natural history, advancing him finally to the position that he so admirably filled to the end. Dr. Schanck was President of the Princeton Gas Light Company at the time of his death, and if I mistake not, had been its President for more than two score years. In 1860 he was elected a member of the Association for the Advancement of Science, and in 1866 Lafayette College conferred upon him the degree of Doctor of Laws. His death occurred on the morning of the 16th inst., and it meant the closing of a life that opened in 1817. I should have said that he rated as Professor emeritus in Princeton, since 1892. He was a kindly man, whose life and ways were of that even tenor that endeared him to all; which is saying much of one who deals with the 'under grad.'"—R.

NOTES.—The rate war in Trenton, N. J., and the competition as well, is over; an undertaking concern having buried the differences which existed in the gas supply of that city. The victors seem to be the folks behind the Peoples Gas Improvement Company. Meanwhile the rate for gas (last week it was 25 cents per 1,000 cubic feet—more or less) has been "readjusted" to $1 per 1,000, which looks to a disinterested observer about 25 cents per 1,000 under what it should be. It seems that an actual consolidation of the generating plants of the Trenton Gas Light Company and of the Peoples Gas Improvement Company should now be a good move.——Mr. Louis J. Belloni, of the gas coal firm of Belloni & Co., noted in the gas trade of this section for over two score years, died last week, at his home in this city, in the 71st year of his age. He was born in New York, in 1827, and was a son-in-law of the dead Mr. Fred. C. Havemeyer, whose sons (H. O. and the late Theodore) gained lasting fame through their connection with the sugar-refining industry of America.——The proprietors of the Peoples Gas Company, of Rutland, Vt., have notified their customers that the selling rate is to be reduced to $2 per 1,000 cubic feet, the concession to date from the 1st prox.

Electric Seasoning of Wood.

The *Builder* (London) notes that an attempt is being made to perfect the seasoning of wood by means of electricity. The timber is immersed about half its depth in a tank of water, and an electric current is applied through a metallic conductor, so arranged as to distribute the current through the whole area. In about 4 minutes the sap begins to exude at the lower end of the stick, and in 6 hours it is all extracted. In another tank an antiseptic solution is then forced into the empty pores by an electro-capillary process. The cost of doing all this is not stated.

Acetylene.—The Third of a Series of Four Lectures, by Prof. Vivian B. Lewes, before the Society of Arts, London.

LECTURE NO. 3.—*The Commercial Generation of Acetylene.—The Types of Generator in Use.—The Actions Taking Place in Acetylene Generators, and the Effect upon the Gas Produced.—The Purification of Acetylene for Domestic Consumption.*

Used as I have been to chemical actions of all kinds, more especially in the development and use of gases, I shall never forget the impression made upon my mind when, in the autumn of 1894, I first generated acetylene by the action of water upon calcic carbide, obtained from Mr. Willson in America. There was something almost "uncanny" in the development of this wonderful gas from the simple contact of the carbide with water, and I was the more impressed by it as I had spent several years in researches necessitating the making of considerable volumes of acetylene, and had realized to the full the laborious and unsatisfactory nature of all the earlier methods for its production. It was with this carbide that I then made the experiments detailed by me in a paper read to the Society in January, 1895, when I showed, for the first time in this country, the reactions which had caused me such keen delight, and also showed, for the first time in any country, how the gas could be consumed so as to develop to the full its marvellous illuminating power.

In the generation of acetylene from calcic carbide and water, all that has to be done is to bring these two compounds in contact, when they mutually react upon each other, with the formation of lime and acetylene, whilst if there be sufficient water present the lime combines with it to form calcic hydrate.

I.

Water H_2O Lime

Calcic carbide CaC_2 Acetylene

and

II.

Lime Water Calcic hydrate

$CaO + H_2O = Ca(HO)_2$

The wonderful simplicity of the reaction is its great beauty, and one would imagine that but little scope was afforded to the mechanical ingenuity of inventors in devising methods by which the necessary contact between the interacting bodies should be brought about. But a glance through the patent literature of the last few years shows that where there is a will there's a way, and many of the weird devices protected under the name of acetylene generators would lead one to suppose that the formation of this beautiful illuminant was one of the most complex problems ever submitted to the ingenuity of man.

There are manifestly two methods by which the carbide and the water can be brought together—either by adding water to carbide, or carbide to water; whilst a slight amount of novelty can be introduced by allowing the water to rise in contact with the carbide from below, *i. e.*, by bringing the water to the bottom of the carbide instead of to the top.

I showed these three methods of procedure when I first described acetylene, and at the time thought that the question of generators was practically done with; but within a few months the idea arose of making automatic generators, so that the space necessary for a small holder should be saved by making the apparatus only generate the gas as it was needed, and a multitude of devices for stopping the generation of the gas when the consumption ceased were designed and placed upon the market. Unfortunately, the designers of these machines, although gifted with much ingenuity and mechanical skill, had but little idea of the properties of the body with which they were dealing; and as a result many of the generators, if not actually dangerous, are so arranged as to generate the gas in anything but its purest form, whilst some give a far smaller yield of gas per unit weight of carbide decomposed than others constructed on more rational principles.

The different forms of apparatus shown at the exhibition at the Imperial Institute, held this summer under the auspices of the Society, may be taken as representing the best types on the market, and when, in a few weeks hence, the report of the committee is published, much interesting matter will be found in it, as, a uniform quality of carbide being used throughout the exhibition, for over a month's continuous working, direct comparison between the performances of the various generators becomes possible.

In considering the various forms of apparatus it will be well to divide them, in the first place, into two classes—(1) The automatic, in which the storage capacity for acetylene is less than the total volume of gas the charge of carbide is capable of generating, and which depends upon

some special arrangement for stopping the action of water on the carbide when the consumption ceases. (2) The non-automatic, with which there is a holder of sufficient size to contain the whole of the gas generated from the charge of carbide which is used.

Each of these classes may be subdivided under three heads:

(*a*.) Those in which water is, by various devices, allowed to drip or flow in a thin stream on to a mass of carbide, the evolution of the gas being regulated by the stopping of the water feed.

(*b*.) Those in which water in volume is allowed to rise in contact with the carbide, the evolution of the gas being regulated by the water being driven back from the carbide, by the increase of pressure in the generating chamber, or by the rising bell of the gasholder drawing the carbide up out of the water.

(*c*.) Those in which the carbide is dropped or plunged into an excess of water.

The points to be attained in a good generator are:

1. Low temperature of generation.
2. Complete decomposition of the carbide.
3. Maximum evolution of the gas.
4. Low pressure in every part of the apparatus.
5. Ease in charging and in removal of the residues.
6. Removal of all air from the apparatus before generation of the gas.

When carbide is acted upon by water, considerable heat is evolved. To determine what this amounted to, a good sample of commercial carbide, containing 92 per cent. of true carbide, was experimented with as follows: A rough calorimeter was made by jacketing a beaker, about 5 inches in diameter, with cotton wool. This arrangement, though crude, answered its purpose well, as experiment showed that some hot water placed in it only lost 0.2° C. after standing for 10 minutes in a room at 18.6° C., a loss which could be neglected. A piece of carbide the weight of which was known was dropped into a liter of water at a known temperature, and the moment that the evolution of gas ceased the temperature of the water was taken, the results being as follows:

Grammes of Water Taken.	Grammes of Calcic Carbide.	Rise in Temperature °C.	Corresponding Calories Liberated.	Number of Calories Liberated per Gramme of Carbide.	Time of Reaction in Seconds.
1,000	42.7	17.4	17,400	407	52
1,000	28 9	11.4	11,400	394	91
1,000	19.7	8.2	8,200	416	73

which gives as an average 406 calories liberated for each gramme of carbide.

Broken up carbide, the pieces of which weighed from 1 to 5 grammes, was next thrown into a liter of water, in the beaker, in quantities of 30, 40 and 50 grammes, respectively:

Grammes of Water Taken.	Grammes of Calcic Carbide.	Rise in Temperature °C.	Corresponding Calories Liberated.	Number of Calories Liberated per Gramme of Carbide.	Time of Reaction in Seconds.
1,000	50	17.6	17,600	352	248
1,000	50	18.4	18,400	368	86
1,000	50	18.3	18,300	366	123
1,000	50	18.4	18,400	368	106
1,000	40	15.6	15,600	390	109
1,000	40	15.8	15,800	395	101
1,000	40	15 0	15,000	375	196
1,000	40	15.5	15,500	387	110
1,000	30	11.7	11,700	390	76
1,000	30	10.8	10,800	360	89
1,000	30	11.8	11,800	393	114
1,000	30	11.4	11,400	380	85

or 377 calories liberated for 1 gramme of carbide.

The last experiment was repeated with carbide still more finely divided, and the results gave 384 calories for each gramme of carbide.

From these figures it will be seen that, contrary to expectation, the smaller the carbide the less was the yield of heat. The reason for this can soon be made evident. More time is spent in weighing out the finer carbide than in taking the weight of one large piece, and the larger surface presented by the small pieces causes greater decomposition by the moisture in the air than occurs with the single lump; hence the carbide is of poorer quality. Also the more rapid evolution of gas in the case of the small carbide prevents the water abstracting all the heat from it. Taking this into consideration, the 406 calories will most nearly represent the heat evolved by the decomposition of 1 gramme of good commercial carbide, and this would be equivalent to 414.6 calories for pure carbide. With this figure as a basis, it is evident that the action develops about one-twentieth of the heat evolved by the combustion of carbon.

The intensity of the temperature developed depends on the time needed to complete the action. The decomposition of the carbide by water is extremely rapid, and the degree of heat attained varies with every form of generator, so that whilst the water in one form may never reach the boiling point of water, the carbide in another may become red hot, and give a temperature of over 800° C. When water drips upon carbide, as in generators of sub-division *a*, the temperature rapidly rises, until it reaches a maximum, in about 18 to 25 minutes, the actual heat developed depending upon the rate of flow of the water and the way in which it is distributed over the mass. But it is quite possible, with generators of this class, to reach from 400° to 700° C, and it is probable that in some parts of the mass the higher limit is nearly always attained, traces of tar being generally found in the residual lime, and in some cases tar is present in sufficient quantity to make the lime yellow and pasty, whilst vapors of benzene and other polymerization products freely pass off with the gas.

Leaving the question of the temperature developed in this class of generator, another important point is the length of time over which generation of gas continues after the addition of water to the carbide has ceased. Makers of automatic apparatus of this type seem to think that all they have to do in order to stop the evolution of acetylene, is to cut off the water supply. This would act very well if the generation of gas really ceased then; but this is not the case, as the gas continues to be evolved, although with increasing slowness, for a considerable period after the cutting off of the water. The length of time over which this after generation extends will, of course, depend, to a certain extent, upon the amount of water added, the amount of carbide undecomposed, and the temperature of the carbide at the time when the water supply is stopped, whilst the generation will itself depend upon (a) the dehydration of the calcic hydrate first formed, and (b) the decomposition of the water condensed from the gas present as the temperature of the generator falls.

As we have before seen, the first result of the action of water upon the carbide is the formation of quicklime and the evolution of acetylene, whilst if sufficient water be present the lime takes up another molecule of water to form calcic hydrate. This molecule of water, however, at temperatures of from 420° to 430° C., is driven off from the calcic hydrate, and the affinity of the carbide for any water present causes the reaction,

$$CaC_2 + Ca(HO)_2 = 2CaO + C_2H_2.$$

A series of experiments was made by placing a known weight of carbide in a generating cylinder, running in a known volume and weight of water in a given time, and carefully measuring the volume of gas for the first ten minutes and again when the action had practically ceased. Not more than 1 cc. of gas was evolved in the ten minutes. The results so obtained show clearly that in any apparatus on this principle the cut-off should be so arranged that at least one-fourth of the total holder capacity is still available to store the slowly generated gas.

An important point was noticed in these experiments—viz., the large excess of water required to insure complete decomposition of the carbide, over and above the theoretical quantity; and the excess of water needed was largely dependent upon the form of generator employed. According to theory, 64 parts by weight of carbide require only 36 parts by weight of water to completely decompose them and convert the lime into calcic hydrate. This would mean that each pound of carbide needs a little under half a pint of water to complete the action. In practice, however, owing to the evaporation due to the heat of the action, half the added water is driven off, as steam, with the acetylene, or left mechanically adhering to the lime, and the smallest quantity likely to complete the action would be a pint to a pound of carbide, whilst in reality the only safe way is to add sufficient water to drown the residue. If this is not done, the lime forms so protective a coating to the carbide that small quantities often remain undecomposed, and if the residues are thrown into a drain or cesspool, the evolution of acetylene would give an explosive mixture, which, on account of its low point of ignition, would be a serious danger.

The second subdivision of generators (*b*), in which water rises to the carbide, is very popular, and overheating can be avoided in these, provided they are so arranged that the water is never driven back from the carbide, and that the charge of carbide used is not too great. Under these conditions, the slowly rising water is always in excess at the point where it decomposes the carbide, so that the evaporation, by rendering heat latent, keeps down the temperature, and although the steam so formed partly decomposes the carbide in the upper portion of the charge, the action is never sufficiently rapid to give any very great rise of temperature. In order to fulfil these conditions, it is necessary that there should be a holder of considerable capacity, and that the leading tube conducting the gas from the generator to the holder should be of sufficient diameter to freely take away the gas, the water being allowed at the same time to rise in the generator so slowly as to do away with any risk of over-generation. In the best generators of this class these

conditions are more or less approached, and it is unusual to find that the melting point of tin, 228° C., has been reached in the charge of carbide during decomposition.

Where apparatus of this class are automatic and have no rising holder to take the gas, it is found that they work satisfactorily when supplying the number of lights for which they were designed; but if they are over driven and the action becomes too violent, excessive heating takes place, whilst the turning off of the gas and consequent driving back of the water from the carbide has also a tendency to cause it. If, however, the water has risen sufficiently slowly, the carbide below the surface has been practically all decomposed, so that the heating only takes place over a limited zone.

The generators of subdivision *c* are the worst offenders as regards excessive heating, the charge of carbide in some of them frequently becoming red hot, whilst the lime taken from them is highly colored, and often black, from the formation of tar and carbon.

The moment that acetylene is subjected to the action of high temperatures, changes of great complexity begin. These at first are purely synthetical. At temperatures which are comparatively low, the acetylene begins to condense to benzene. As the temperature rises, the condensation off our molecules of acetylene yields styrolene. A further increase in the temperature may cause the styrolene and benzene to interact, yielding anthracene and hydrogen; and it is probably at this point that the brown tar vapors appear, whilst naphthaline is also formed. At this temperature, moreover, a fresh set of interactions starts. The nascent hydrogen combines with acetylene to form ethylene, and this body, under the action of heat, breaks down into methane and acetylene once more. When the outer layer of carbide decomposes, the gas is evolved so rapidly that there is no time for the heat to act upon it; but as the decomposition spreads into the center of the mass, the acetylene generated has to pass through the external layers, which, as shown, may be at a temperature above the point of its decomposition, and it is under these conditions that a considerable volume of gas is lost, and the tar often found in the residue or distilled out into the tubes is formed.

In generators in which excessive heating takes place the tar is likely to cause considerable trouble, as it is of a very viscous nature; and if it condenses in the delivery tubes it causes the lime dust and carbon particles to collect and bring about stoppage. A still more important evil, however, is to be found in the alteration which takes place in the composition of the gas, and which reduces its illuminating power to a serious extent. Two samples of gas taken whilst the charge in one of these generators was overheating gave the following results on analysis:

	I.	II.
Acetylene	70.0	69.7
Saturated hydrocarbons	11.3	11.4
Hydrogen	18.7	18.9
	100.0	100.0

Such a mixture would only have about one-half the illuminating value of pure acetylene. The large amount of hydrogen present in these samples also shows that decomposition of some of the acetylene has taken place; and a considerable deposit of carbon is often found in the generator.

At first sight these results seem an absolute condemnation of the second subdivision of apparatus; and the rising bell which draws a mass of wet carbide above the surface of the water should at once be discarded, as it is bad from every point of view. But generators in which water rises from below, and so attacks the carbide, can be made safe if the arrangements are such that the water is never driven back from the carbide, and the bulk of carbide is sufficiently subdivided.

The generators of the third class are those in which carbide is allowed to fall into an excess of water, and these have many advantages. In such generators, as long as there is water present, it is impossible to get above a temperature of 100° C., unless lime sludge is allowed to collect at the bottom, when the carbide will get hot enough to sometimes melt zinc, whilst, with a properly arranged tank, the temperature never exceeds the air temperature by more than a few degrees. Under these conditions the absence of polymerization and the washing of the nascent and finely divided bubbles of gas by the lime water in the generator yield acetylene of a degree of purity unapproached in any other form of apparatus. The one thing that has militated against it is that it is not easy to design such a generator which shall be automatic, and as this seems to be the craze from which all generator makers are at present suffering, its advantages have been apparently overlooked by them, although fully recognized by all scientific men.

This form of generator, however, although exhibiting the great advantages enumerated above, has the drawback of being one of the least economical in the output of acetylene per pound of carbide used, as the gas, having to bubble through the water, is rapidly dissolved by it, whilst in an apparatus in which only the surface of the water touches the gas the amount dissolved is comparatively small. The result of this is that with generators of this class the generation rarely exceeds 4.2 cubic feet of acetylene per pound of carbide, instead of over 5 cubic feet per pound.

As regards the complete decomposition of the carbide, it has been already pointed out that in generators of the first subdivision there may be a small quantity of the carbide left undecomposed, if water enough to flood the residuum be not admitted, whilst in non-automatic generators of the second subdivision this is practically impossible. In generators of the third subdivision, in which carbide drops into a large excess of water, it might be imagined that any carbide in the residue was an impossibility, but in point of fact this class is often the worst offender in this respect, as, if the generation has been in action for some time, a thick sludge of lime collects at the bottom of the generator, into which the carbide sinks, and a large lump of carbide will often bake for itself so tough a layer of oil and lime that it resists the action of the water, and is found unacted upon when the generator is cleaned out. The usual explanation given by the generator maker is that it is crust present in the "bad carbide." In a good generator the maximum yield of gas should be evolved from the carbide, but a fact which the generator makers have entirely overlooked up to the present time is that if you take a number of different machines and supply them all with exactly the same carbide, no two will give the same yield of gas, the best generators giving volumes approximating to 5 cubic feet per pound of carbide, whilst the worst will give barely 4 cubic feet, a result, as usual, placed at the door of the carbide.

The causes which tend to diminish the volume of acetylene given off are:

1. Undue pressure in the generator.
2. The acetylene after generation having to pass through a column of water.
3. Undue heating, causing polymerization.

The first of these is very noticeable, and is due to the increased volume of gas dissolved by water under pressure. Although 10 volumes of water at ordinary atmospheric pressure only dissolve 11 volumes of acetylene, at 2 atmospheres pressure it dissolves double the quantity. When acetylene is generated at or above the surface of water, but little dissolves at once, the top layer of water rapidly becoming saturated; but when the gas has to bubble up through a mass of water, as in generators of the third class, a heavy loss from solution takes place. The last cause has already been discussed, and is not so noticeable in its result.

The pressure in all parts of a generator should be as nearly as possible equal, and as low as possible, and this is best obtained by working freely into a gasholder of sufficient size. The Home Office fixed 100 inches of water as the limit of pressure permissible in generators, but I think it was a mistake to allow more than 20 inches, and I should certainly not advise the use of a generator which gave more than that amount.

Every part of the generator should be easily accessible, and complicated taps and valves should be avoided, whilst ease of charging and clearing out should be attended to, and ample room provided in the generator for the increase in bulk which takes place when carbide is converted into lime. One pound of pure calcic carbide yields 1.15 pounds of slaked lime—one kilo. of carbide yields 1,155 grammes of slaked lime—and the volume this will occupy depends entirely upon the way in which the water is brought in contact with it.

In an automatic generator of the first subdivision, where water drips slowly upon the carbide in sufficient quantity to decompose it but not to flood it, the lime swells up and occupies from 2 to 2.5 times the bulk of the original carbide; when, however, the water flows in more rapidly, the impact of the water beats down the lime, and the space occupied is not so large. In generators of the second class, in which water rises from below, the weight of the undecomposed carbide above it presses down the line below and keeps it in a compact mass, occupying about one-half more space than the carbide from which it was formed. In designing a generator of the third subdivision, the tank containing the water into which the carbide falls should be provided with a false bottom, so as to leave at least 8 inches to 1 foot of water below the point at which the carbide is decomposed for the lime sludge to settle in.

Experiments were made to see the rate at which the settling of the excess of lime took place, In these experiments known weights of calcic carbide were dropped into a beaker containing a liter of water, and the results obtained were as follows:

I.

Water Taken, Grams.	Calcic Carbide. Grams.	Volume of Lime Paste —Deposited During— 30 Mins. c.c.	90 Mins. c.c.	Volume of Lime Paste —Deposited During— 30 Mins. For 1 Gram, CaC2.	90 Mins.
1,000	50	480	360	9.6	7.2
1,000	50	470	340	9.4	6.8
1,000	50	440	350	8.8	7.0
1,000	50	470	370	9.4	7.4
1,000	40	430	330	10.7	8.0
1,000	40	420	320	10.5	8.0
1,000	40	400	310	10.2	7.7
1,000	40	410	320	10.5	8.0
1,000	30	340	240	11.0	8.0
1,000	30	320	220	10.3	7.3
1,000	30	350	240	11.0	8.0
1,000	30	350	240	11.0	8.0
			Mean....	10.2	7.6

II.

1,000	50	450	340	9.0	6.8
1,000	50	440	330	8.8	6.6
1,000	50	450	330	9.0	6.6
1,000	50	440	320	8.8	6.2
1,000	40	390	310	9.7	7.7
1,000	40	410	310	10.0	7.7
1,000	40	390	300	9.7	7.5
1,000	40	390	300	9.7	7.5
1,000	30	310	210	10.3	7.0
1,000	30	300	240	10.0	8.0
1,000	30	240	230	9.6	7.6
1,000	30	300	220	10.0	7.3
			Mean....	9.8	8.6

After 30 minutes the volume of lime was 10 c.c. per gramme of carbide. After 90 minutes the volume of lime was 8.1 c.c per gramme of carbide. So that, approximately, after an hour's standing, each kilo of calcic carbide will give 10 liters of lime sludge, or 1 pound of calcic carbide will yield 8 pints, which can be got rid of by a sludge cock at the bottom of the apparatus. The rapidity with which settling takes place is, of course, slightly affected by the form of the apparatus.

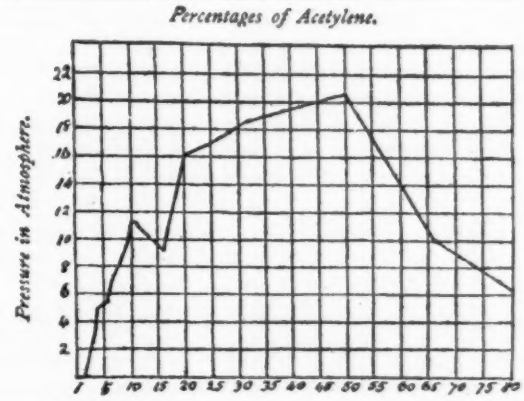
Another requisite of a good generator, overlooked up to the present time, is that there should be an arrangement by which the air present in the generator can be rinsed out by some of the acetylene already in the holder, or by some inert gas like carbon dioxide. I think this is a most important precaution, as recent researches by Mr. H. Gerdes show that instead of acetylene requiring to be diluted with about 12 times its bulk of air in order to obtain the maximum pressure on explosion, mixtures of equal volumes of acetylene and air give the most powerful result. It must be remembered that the temperature at which acetylene decomposes into carbon and hydrogen, with evolution of heat, is 780° C., but the temperature of ignition is 480° C ; and in such a mixture the degree of heat needed to cause explosion will more nearly approach the latter than the former temperature, and it is quite conceivable that in working on a big scale the carbide might easily reach the necessary temperature whilst such a mixture of acetylene and air still remained in contact with it. Indeed, I have come across several cases of explosion which could only be explained by this.

Working with 90 liters of the various mixtures in an explosion cylinder, and measuring the pressures by means of a manometer and indicator, the following results were obtained :

Pressures Given by Exploding Mixtures of Acetylene and Air.

Percentage of Acetylene.	Pressure. Atmospheres.	Percentage of Acetylene.	Pressure. Atmospheres.
2.5	0.05	11.1	11.1
3 7	3.7	12.5	10.6
4.7	4.9	16.6	7 2
5 5	5.2	20.0	16.0
6.6	6.8	25.0	16.9
7.7	8.2	33.0	18.4
8.3	8.6	50.0	20.3
9 1	9.7	66.0	10.0
10.0	11.1	80.0	6 3

If these results be plotted out in a curve, it will be seen that there are two maxima of explosive force. The first maximum of pressure occurs when completed combustion yields the greatest heat effect, and the acetylene is burned to carbon dioxide and water vapor ; and this mixture explodes with the greatest noise. Mr. Gerdes explains the second maximum of pressure by the assumption that the carbon is gaseous at the moment of liberation, but I do not think this theory is tenable. If a mixture of equal volumes of acetylene and air be ignited in an open cylinder 18 inches high, a lurid disc of flame runs down the cylinder, and a vast cloud of carbon is given off, but no sign of anything approaching explosion occurs. If, however, this be done in a closed vessel, the very slowness of the combustion brings about the



explosion, as the combustion of the portion of the mixture first ignited creates a pressure under which the remainder detonates at the temperature of combustion, and gives the high pressure noticed in those experiments,

In experiments which I have made I have found it extremely difficult to ignite such a mixture of air and acetylene in a tube by means of an electric spark, but if a flask be employed, so that a considerable volume of the mixture is present, the spark at once causes a violent explosion, the finely divided particles into which the glass is blown being an ample proof of the explosive force having been of an extremely sharp character.

The fact that a mixture of 1 volume of air and 1 volume of acetylene burns extremely slowly in an open cylinder, and also the fact that it is difficult to ignite by a spark the mixture in small portions, is no argument against the explosibility of the mixture, as if you take a mixture of carbon disulphide and nitric oxide in a short cylinder, it burns with simply a bright flash of light, which is noted for its richness in actinic rays ; whereas, if a very long, narrow cylinder be employed, it burns down to a certain point, and then detonates, blowing the cylinder to pieces, such phenomena being entirely due to the increase in rapidity of combustion, which finally terminates in an explosive wave.

A good deal of the troubles arising in generators is due to the irregular development of the acetylene, which at first comes off with tremendous rapidity, and then, as the exterior carbide becomes coated with lime, gets slower and slower, whilst the after cracking off of this coating then gives irregular rushes of gas. Many attempts have been made to get over this trouble, perhaps the most successful being the decomposition of the carbide by means of a solution of sugar, which has the power of dissolving the lime as it is formed, and so gives a uniform and less rapid evolution of gas. It, of course, increases the expense, and it would only be available in the generators of table and bicycle lamps, where cost is a secondary consideration. Alcohol, also, when mixed with the water, tends to regulate the generation. The effect of various oils in regulating the evolution of the gas has also been tried with a certain amount of success. If the carbide is coated with oil it is protected from the action of water all the time the oil is clinging to the material. In one form of automatic generator a layer of light oil is placed on the surface of the water. As the water rises past the carbide the oil rises with it, and the action of the water on the carbide commences a few minutes after the water has come in contact with it and has had time to displace the oil, whilst on cutting off the gas the water is again driven down, and as the oil on its surface comes in contact with the partially decomposed carbide it is supposed to coat it, and stop the after generation. With very small generators working well within their capacities this may be successful, but with any large charge of carbide the heat remaining in the lumps of solid material would probably be sufficient to distil out some of the light oil employed.

In concluding this part of the subject I can only say that I believe that as time goes on the tendency on the part of acetylene cousumers will be to use the simplest form of generator available, with a holder proportionate to the needed consumption.

Abroad a good deal of work has been done on the purification of acetylene. Purification is desirable with the smallest installation, but it becomes imperative when small towns or villages are to be supplied with acetylene instead of coal gas. As was pointed out in the last lecture, the purity of acetylene gas primarily depends upon the purity of the carbide from which it is formed, and as long as it is commercially impossible to use absolutely pure calcic oxide and carbon so long will there be always present in this material calcic phosphide, aluminum sulphide, and magnesium nitride, which, in the decomposition of the mass by water, will yield a gaseous and unwelcome addition to the acetylene of phos. horeted hydrogen, sulphureted hydrogen, and ammonia.

Phosphoreted hydrogen, when it burns in the acetylene flame, gives rise to phosphorus pentoxide, which escapes into the atmosphere in the form of white fumes, and although the quantity is so minute that it is invisible as it leaves the flame, still, when mingled in quantity with the air of an ill-ventilated room, it is the primary cause of the production of the light haze which, ever since the introduction of acetylene for illuminating purposes, has been recognized as a serious inconvenience in connection with it.

The atmosphere in a warm room always contains large quantities of water vapor, derived both from the respiration of the occupants and from the products of the combustion of the illuminating flame, and under ordinary conditions this moisture remains suspended in the atmosphere in an invisible state; but as soon as traces of phosphorus pentoxide escape into it, this substance, having a marvellous affinity for water, causes a condensation of a portion of the water vapor and converts it into phosphoric acid, so that a very small trace of phosphoreted hydrogen in the gas itself gives rise to an amount of haze totally out of proportion to the actual phosphorus present, and where there is a considerable quantity of acetylene consumed, and no proper method of changing the air of the room, this haze will often be found, and is undoubtedly injurious to health. I do not myself think that the whole of the onus of the haze can be laid at the door of the phosphoreted hydrogen in the acetylene, but it undoubtedly plays an important part in this action, upon which I am at present experimenting.

The sulphureted hydrogen, formed by the action of water on the aluminum sulphide, in the gas is objectionable, not so much because it renders the smell of the acetylene offensive—an effect which I look upon as a safeguard—but because, in its combustion in the acetylene flame, it forms sulphur dioxide, which, in ill ventilated apartments, will absorb oxygen and moisture from the air, and will in this way become converted into minute traces of sulphuric acid, which, concentrating themselves upon any cold surface in the room, in the form of impalpable moisture, give rise to corrosion of metals, and, in time, destruction of the binding of books, although the effect is but small upon such fabrics as have not the power of absorbing moisture or condensing it from the atmosphere.

The chief objection to the third impurity present in the acetylene gas (ammonia) is that it leads to rapid action upon the brass gasfittings, and is also an important factor in producing explosive compounds of acetylene with metals, although the experiments of Mr. Gerdes have shown that this is not a very real danger.

It is quite clear, however, that if acetylene is to be used on a large scale as a domestic illuminant, it must undergo such process of purification as will render it harmless and innocuous to health and property, and the sooner it is recognized as absolutely essential to purify it before consuming it, the sooner will the gas acquire its deserved meed of popularity, and I think I shall be able to show in the next lecture that many other troubles will at the same time be overcome.

The only impurity which offers any difficulty in removing is the phosphoreted hydrogen. There are three substances which can be relied on to remove this compound. The three methods are to pass the gas to be purified either through acid copper salts, through bleaching powder, or through chromic acid. In experiments with these various bodies it is found that they are all of them effective in also ridding the acetylene of ammonia and sulphureted hydrogen, provided that the surface area presented to the gas is sufficiently large.

The method of washing the gas with acid solutions of copper has been patented by Herr A. Frank, of Charlottenberg, the celebrated gas engineer, who found that a concentrated solution of cuprous chloride in an acid is the most effective metallic solution to be employed, and where the production of acetylene is going on on a small scale, this method of purifying is undoubtedly the most convenient one, as the acid present absorbs the ammonia, and the copper salt converts the phosphoreted and sulphureted hydrogen into phosphates and sulphides. The vessel, however, which contains this solution has to be of earthenware or porcelain, on account of the free acid present. The gas must also be washed, after purification, to remove traces of hydrochloric acid, and care would have to be taken to prevent the complete neutralization of this acid by means of ammonia. The second process is the one patented by Dr. Ullmann, of Geneva, who utilizes chromic acid, which oxidizes the phosphoreted and sulphureted hydrogen, and absorbs the ammonia, whilst the third process owes its inception to Lunge, who recommends the use of bleaching powder. But Dr. Wolff has found that when this is used on a large scale there is a risk of the ammonia present in the acetylene forming traces of chloride of nitrogen in the purifying boxes, and as this is a liquid which detonates with considerable local force, it occasionally gives rise to explosions in purifying apparatus. If, however, the gas is first passed through a scrubber, so as to wash out the ammonia, this danger is got rid of. Dr. Wolff employs purifiers in which the gas is washed with water containing calcic chloride, and it is then passed through bleaching powder solution, or other oxidizing material.

The form of apparatus employed in the generation of acetylene has remarkable influence upon the proportion of sulphureted hydrogen and ammonia present in the gas, although it affects but little the quantity of phosphoreted hydrogen. A long series of experiments which I have made shows that when the acetylene is generated in machines of the third subdivision the ammonia is entirely eliminated, whilst the passage through the lime water reduces the amount of sulphureted hydrogen present to a mere trace, which may be neglected, but has little or no effect upon the phosphoreted hydrogen.

Analyses by Dr. Wolff of acetylene generated from American, German and Swiss carbide, as at present made, give the following results:

	American.	German.	Swiss.
Phosphoreted hydrogen	0.05	0.03	0.03
Sulphureted hydrogen	0.08	0.07	0.10
Ammonia	0.08	0.07	0.11
Hydrogen	0 09	0.07	0.16
Nitrogen	0.42	0.20	0.34
Oxygen	0.87	0.55	0.63
Acetylene	98.41	99.01	98.63
	100.00	100.00	100.00

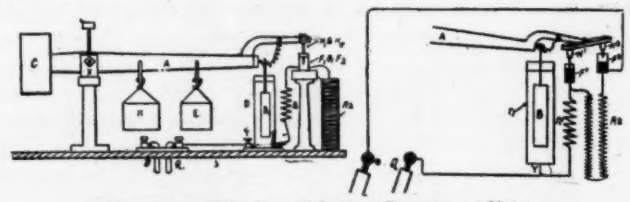
Analyses which I have lately made from the ordinary commercial English carbide, and from the pure carbide made in France in the Herolt furnace by the tapping process, are as follows:

	English.	French.
Phosphoreted hydrogen	0.138	0.045
Sulphureted hydrogen	0.064	0.048

On taking a sample of English carbide and decomposing it by the dripping process, there is found 0.138 per cent. of phosphoreted hydrogen and 0.064 per cent. of sulphureted hydrogen, whilst if this carbide be allowed to fall into water the acetylene so generated contains 0.126 per cent. of phosphoreted hydrogen and the sulphureted hydrogen is practically eliminated. When the carbide is dropped into a solution of sugar the same result is obtained, and no traces of sulphureted hydrogen can be detected in the gas so generated.

The Long-Schattner Prepayment Electric Meter.

One of the principal and we may say necessary, requirements of a prepayment meter is its extreme simplicity and cheapness, in preference to great accuracy over a large range and long running power. The sums of money collected are generally small and the installations are not of sufficient size to warrant the purchase of a complicated and expensive instrument. Besides, the visits of inspectors are so frequent that long running meters are not required. These considerations, however, do not in the least alter the general opinion of engineers that a mechanical meter is to be preferred for such a class of work, to one dependent on electrolytic action, even if the price is in favor of the latter. It is true that the mechanical simplicity, freedom from frictional errors and capacity of accounting for the smallest currents are very great recommendations for the chemical meters, but they have



Figs. 1 and 2.—Long Schattner Prepayment Meter.

certain disadvantages. There is usually a serious fall of potential in the cells, and they are liable to corrosion and decay. These, however, are somewhat kept in check or eliminated by high voltages and care. A meter of this class, which in principle somewhat resembles the old Edison meter, has, we understand, lately met with considerable success at Norwich, England. It is the Long-Schattner meter, shown in perspective in Fig. 3 and diagrammatically in Figs. 1 and 2, the latter being a plan of connections. Referring to the figures, *A* is a lever pivoted at *X*. At the far end of the lever is suspended a copper plate *B*, which is immersed in a solution of copper sulphate. The box, *D*, is also of copper, and forms the cathode. *C* is a weight to balance the other side of the lever. *K* and *E* are cups to hold respectively the coins and standard weights with which the collector replaces the coins

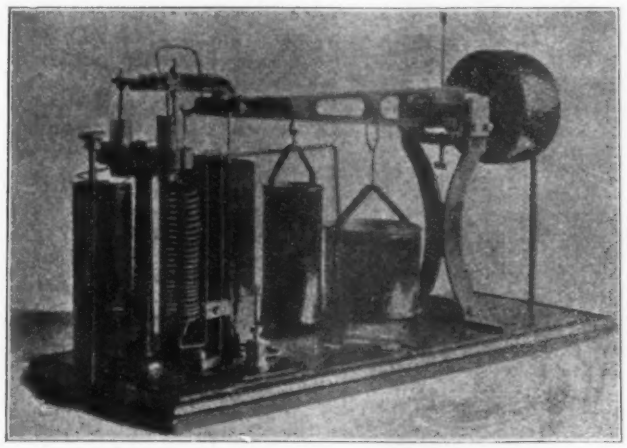


Fig. 3.—Long-Schattner Meter.

he removes. F_1 and F_2 are mercury cups, F_1, the front one, being filled with mercury; F_2, the back one, being half filled with mercury and filled up with creosote oil. H_1 and H_2 are contact pieces forming a bridge across the mercury cups, wnich bridge is fixed on the lever. R_1 is a main resistance, across which the voltmeter goes as a shunt, and R_2 is a large resistance going from one mercury cup to the other. The purpose of this is to prevent total extinction of the light when the switch is open, though there will not be sufficient light to serve any useful purpose until the addition of more money to the scale pan closes the contact, F_2, once more. It also prevents sparking at the mercury surface, since the circuit is never altogether opened. The electrolytic cell is a shunt to the resistance, R_1, and provided the usual troubles concerning uniformity of temperature and resistance are duly overcome, the loss of weight in the anode plate is strictly proportional to the quantity of electricity that passes, and therefore, with uniform pressure of supply, to the electrical energy used.

The customer gains nothing by delay in putting in another coin, since he has to pay for the current passing to keep his lamps burning low; rather he loses by such delay, for the light is during that time by no means proportionate to the energy producing it. The drop across the meter is, at full load, only 0.2 volt, or one-tenth of that across the terminals of a gas-electrolytic meter. By the arrangement that the current enters at the top of the plate and leaves at the bottom of the containing box a uniform deposit is obtained—a matter of some importance to the accuracy of the meter, since the resistance of the electrolyte is thereby kept constant. The meter registers with any, the smallest, current that flows through it, and when correct at any load, is so at all loads. The electrolyte is a copper sulphate solution of 1.115 specific gravity, in a 1 per cent. mixture of sulphuric acid and water. The plate and box will last for 700 units. after which they must be replaced by a fresh plate and box at a cost of about $1.20. A weight fixed vertically above the axis of the lever raises the center of gravity and secures a quick break as soon as the counterpoise overcomes the coins and copper plate, but the movement is not sufficient to prevent the weight even of so small a coin as a three-penny bit from overbalancing the lever and making fresh contact.—*Electrical Engineer.*

Lewes' Method of and Apparatus for Manufacturing Gas.

On December 13th U. S. Letters Patent (No. 615,996) were granted to Prof. V. B. Lewes, of London, England, for an improvement in methods of and apparatus for manufacturing gas—Prof. Lewes had obtained British Letters Patent (No. 2,914, Feb. 9, 1894), for the method and apparatus hereunder described. Using the words of the specification:

I have found by experiment that water gas, hydrogen, or mixtures of the two, when carbureted by the vapors obtained by decomposing hydrocarbons, yield a flame which, although it may be of high illuminating value, is for a given rate of consumption far shorter and smaller than the flame obtained from ordinary coal gas, and that in consequence of this it has to be burned in larger quantities in order to obtain a flame which shall equal in appearance that of coal gas. I have discovered that the longer flame obtained with coal gas is due to the presence therein of from about 35 to 40 per cent. of methane or light carbureted hydrogen, which gives body and length to the flame and which only exists in carbureted water gas or carbureted hydrogen to a considerably less extent than in coal gas—say from about 16 up to 26 per cent. instead of 35 to 40 per cent.

The present invention has reference to an improved method of and apparatus for making gas specially suitable for the manufacture or production of illuminating gas rich in methane, and, therefore, more closely resembling coal gas in this respect than the illuminating gas heretofore produced by the admixture of water gas or hydrogen with the gas obtained from liquid hydrocarbons.

For making such improved gas I employ apparatus of the kind described in my Letters Patent of the United States, No. 538,923, dated May 7, 1895, but which is constructed with a second injector or row of injectors arranged at a lower level than the oil injectors shown in that patent. By means of such lower injector or injectors I inject tar or heavy hydrocarbon oils by means of steam, which may be superheated, into the hottest part of a mass of fuel previously raised to a state of incandescence by blowing air through it, whereby the said tar or heavy hydrocarbon oils will be decomposed, carbon being deposited and added to the bulk of the fuel, while large volumes of methane and hydrogen will be generated. When this injection of tar or heavy hydrocarbon oils has gone on for a sufficient length of time to partly reduce the temperature of the fuel, I then inject into the said fuel by the upper injector or row of injectors lighter hydrocarbons, which, not being decomposed to so great an extent as the others, yield ethylene and other bodies of high illuminating value to the gas obtained. In this way it is possible to use 3 gallons of tar to 1 gallon of lighter hydrocarbon oil to make an illuminating gas of high value.

When tar is used in large quantities for the purpose mentioned, a certain amount of fuliginous matter is carried over with the gas, and where stoppages are likely to be produced from this cause I employ to obviate the same a construction substantially as follows: A gas producer provided with suitable inlets for air, steam and hydrocarbon, as in the apparatus set out in my patent aforesaid, and a regenerator charged with refractory material arranged checkerwise, this regenerator being in communication at the top with the gas producer and at the bottom with a gas outlet and with a tar well or seal, the arrangement being such that when the fuel in the gas producer is being raised to a state of incandescence by the passage through it of air, hot gases and products of combustion will pass through the regenerator and heat the contents thereof to a high temperature, after which the hydrocarbon gas produced by injecting the hydrocarbon into the incandescent fuel will be led direct through the heated regenerator, wherein it will be heated, and any hydrocarbon which may have escaped gasification in the generator becomes converted into a permanent illuminating gas, which will escape by a suitable outlet to a sealed hydraulic main, while any products that might become condensed will pass out through an overflow. To assist the passage of the hydrocarbon gas through the regenerator and to prevent stoppage, a suitably arranged steam jet is provided, the steam decomposing the fuliginous matter with formation of water gas. The regenerator may be advantageously arranged to form part of the same structure as the gas producer, and the checker work therein may be composed partly of firebrick and partly of small pigs or bars of iron, the latter being arranged at the lower part of the regenerator and serving to produce hydrogen, as in the processes described in my Letters Patent of the United States, No. 551,903, dated December 24, 1895.

The outlet pipe from the bottom of the regenerator may be inclined, its upper side being provided with an outlet pipe for the escape of producer gas during blowing, and its lower end being in connection with the seal, suitable removable covers or plates being provided to admit of the pipe being cleared when necessary.

To enable the gas producer to be raised to a suitable state of incandescence in a quicker and more uniform manner than has heretofore been usual, the said gas producer is or may be constructed with one or more air inlets at different levels in addition to the inlet at the bottom of the gas producer, so that two or more blasts of air will be injected into the fuel simultaneously at different points in its height. This arrangement of air blasts may advantageously be used in connection with gas producers for producing gas other than oil gas—as, for example, water gas.

In the accompanying drawings, Fig. 1 shows, partly in front elevation and partly in longitudinal vertical section, and Fig. 2 in end elevation, apparatus suitable for carrying out my present invention and designed to obviate stoppages due to fuliginous matter carried off by the gas produced.

1 is a gas producer comprising an outer metal casing lined with refractory material, such as firebrick, and provided with inlets 2 for fuel and outlets 3 for clinker, these inlets and outlets being normally closed by doors 2a and 3a, respectively.

4 is a pipe through which and the branch pipes 4a air can be blown

Fig. 1.

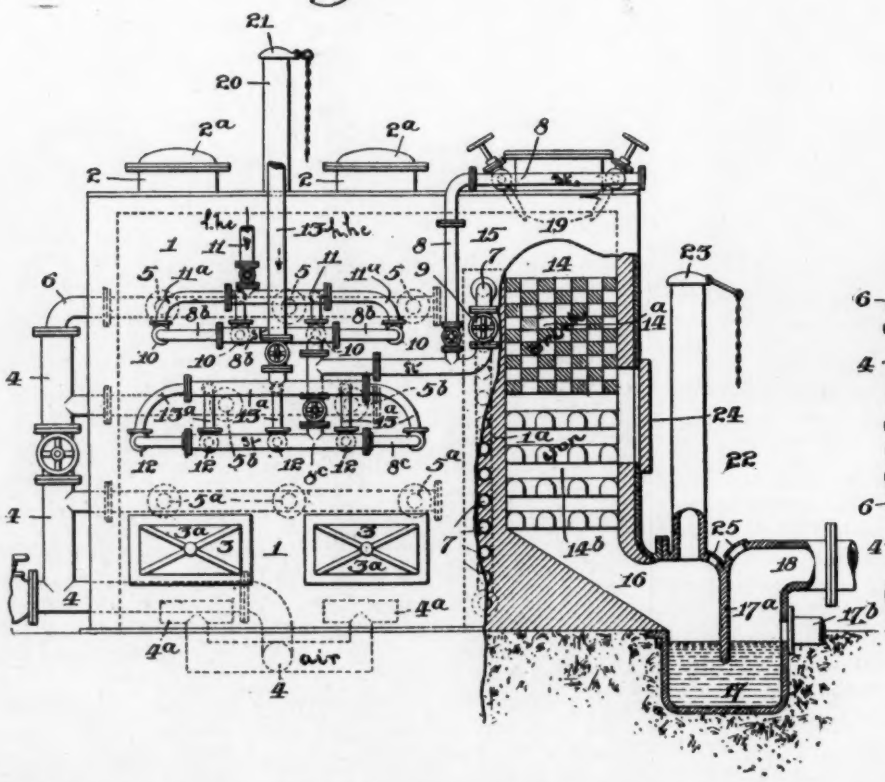
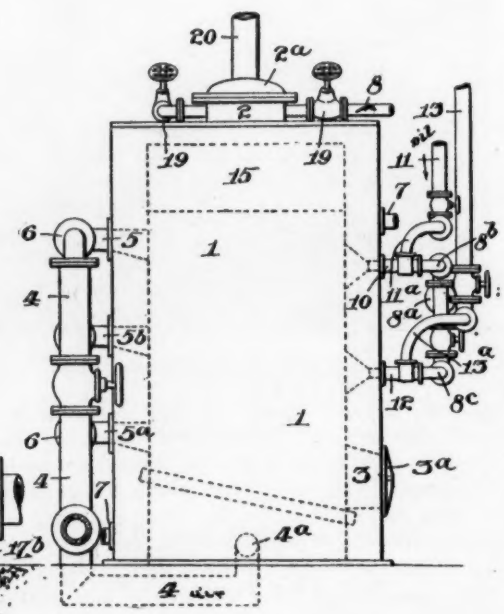


Fig. 2.



from time to time into the bottom of the gas producer, below the grate bars therein, for the purpose of raising the fuel therein to a state of incandescence.

5 and 5a are additional air inlets arranged, respectively, at the upper and lower parts of the gas producer, and 5b are intermediate air inlets, each in communication by a branch pipe 6 with the main air pipe 4, so that several blasts of air can be injected into the fuel simultaneously at different points in its height for the purposes hereinbefore mentioned.

7 is a steam superheating coil imbedded in one of the end walls 1a of the gas producer. One end of this pipe is connected with a steam generator (not shown) and its other end with a pipe 8, provided with a valve 9.

10 are the upper injectors, of which four are shown, through which a light hydrocarbon, supplied by a main oil pipe 11 and branch pipes 11a, is blown into the mass of incandescent fuel in the gas producer 1 by means of superheated steam supplied from the steam pipe 8 by vertical and horizontal branch pipes 8a, 8b, respectively.

12 are lower injectors, of which five are shown, through which ordinary coal tar or heavy hydrocarbon oil, such as furnace oil or crude oil, supplied by a main supply pipe 13 and branch pipes 13a, is blown into the hottest portion of the mass of incandescent fuel in the producer by means of superheated steam supplied from the said steam pipe 8 by the vertical branch pipe 8a and a horizontal branch pipe 8c.

14 is a regenerator that is arranged to form part of the same structure as the gas producer 1. It is charged with refractory material arranged checkerwise, the upper portion 14a of such material being composed of firebrick, while the lower portion 14b consists of small pigs or bars of iron. The regenerator is in communication at the top, by a passage 15, with the gas producer, and at the bottom, by an outlet 16 and tar well or vessel 17, with a gas outlet 18. The tar well or vessel is provided with a vertical division 17a, the lower end of which is sealed by liquid in the said tar well.

19 are steam jets connected with the steam pipe 8 and whereby jets of superheated steam can be introduced into the regenerator for the purpose of assisting the hydrocarbon gas coming from the gas producer 1 to flow downward through the regenerator, and thence to the gas outlet 18.

20 is a vertical pipe to serve as a chimney to facilitate the lighting of the fuel in the gas producer at starting. This pipe is normally closed by a snift valve 21.

22 is an outlet pipe in direct communication with the outlet 16 of the regenerator and through which, upon opening the valve 23 with which it is provided, producer gas is permitted to escape when blowing the gas generator with air to raise the fuel therein to a state of incandescence.

24 is a door, by removing which access can be gained to the regenerator for cleaning or other purpose, and 25 are removable covers or plates to admit of the outlet 16 and pipe 18 being cleared when necessary.

The gas producer may be provided on both sides with air inlets and steam and oil injectors; also, the airblast pipes or passages may be formed in the lining of the gas producer, if desired. The operation of the apparatus is as follows: Carbonaceous fuel, such as coke, is introduced into the gas producer 1, ignited, and then raised to incandescence by air forced through the air inlets 4a, 5, 5a and 5b from the blast main 4, the products of combustion thereby produced, and consisting largely of carbon monoxide and nitrogen, being led away through the outlet 15, down through the regenerator 14, and thence through the outlet pipe 22, the valve 23 of which is then opened. By this means the refractory materials 14a 14b in the regenerator and the end wall 1a of the gas producer containing the steam superheating pipe 7 are raised to the required high temperature and iron oxides on the pigs or bars 14b reduced to metallic iron.

The air blast is then cut off and ordinary coal, tar or heavy hydrocarbon oil, such as hereinbefore mentioned, is introduced through the lower set of injectors 12 by means of superheated steam from the pipe 8 into the lower and hottest part of the mass of incandescent fuel in the gas producer, where it will be decomposed into gas and carbon, the gas containing large quantities of methane and hydrogen, escaping through the heated regenerator 14, and the carbon being added to the fuel in the gas producer 1. During this operation the flow of gas through the regenerator is assisted by jets of steam from the nozzles 19, the escaping gas displacing the liquid seal in the left hand side of the tar well 17 sufficiently to enable it to pass under the division 17a, and thence to the outlet 18, any matters condensed from the gas falling into the tar well, from which they ultimately pass away by an overflow 17b. Owing to the great heat of the regenerator 14 part of the steam admitted thereto from the nozzles 19 will be decomposed, and by combining with fuliginous matter carried over with the escaping gas will form an additional quantity of gas and at the same time prevent choking of the regenerator. After this operation has gone on for a sufficient time to partly reduce the temperature of the fuel the supply of tar or heavy hydrocarbon oil and steam to the lower row of injectors 12 is or may be cut off and lighter carbon, such as paraffine, is injected by means of steam into the upper portion of the mass of red hot or incandescent fuel through the upper row of injectors 10, whereby ethylene and other bodies of high illuminating value are produced, which escape through the regenerator, tar well and outlet pipe 18 and are mixed with the gas containing methane and hydrogen previously produced. This generation of gas is continued until the temperature of the fuel in the gas

producer has fallen below the required point. The steam and hydrocarbon are then shut off and air turned on to the various air inlets 4a, 5, 5a and 5b, so as again to raise the fuel to a state of incandescence, any hydrocarbon remaining in the gas producer assisting the carbon monoxide, generated by the action of the air on the fuel, to reduce to the metallic state any oxide of iron that may have been formed on the pigs or bars of iron in the regenerator by the action of the steam admitted to such regenerator by the nozzles 19, so that such pigs or bars of iron will be ready for re-use when again generating illuminating gas.

Instead of injecting the tar or heavy hydrocarbon oil and lighter hydrocarbon alternately into the gas producer the injection of the former may be continued after the supply of the latter has been turned on, so that at this time both light and heavy hydrocarbon will be injected simultaneously into the gas producer.

The injection of the hydrocarbons with steam directly into the mass of the incandescent fuel forms an important part of the process, for the reason that the steam attacks the incandescent carbon of the fuel, forming water gas, which so protects and dilutes the vaporizing hydrocarbon that the decomposition thereof is arrested before it has gone too far, and as a result a permanent gas of high illuminating value is obtained, the carbon deposited from the hydrocarbon on "cracking" remaining to provide an increased quantity of fuel in the generator instead of choking the apparatus.

When working with a gas producer 1, having the following internal dimensions—viz., 12 feet high, 12 feet wide, and 8 feet from front to back—I have obtained satisfactory results by using 3 gallons of tar to 1 gallon of paraffine, the injection of the former taking about 5 minutes and the injection of the latter about the same time, the steam used being at a pressure of about 100 pounds to the square inch and heated to a temperature of about 400° C. The relative quantities of steam and hydrocarbon admitted through the injectors into the incandescent fuel should be so regulated that the gas generated in the gas producer shall be of brown color.

The inventor's claims are :

1. The method of manufacturing illuminating gas, which consists in blasting a bed of fuel to incandescence, injecting heavy hydrocarbons with steam directly into the lower and hottest part of the fuel, thereby decomposing the hydrocarbon into gas and carbon, whereof the gas contains large quantities of methane and hydrogen, water gas being formed at the same time, and injecting a lighter hydrocarbon with steam directly into the fuel at a higher level, to produce hydrocarbon and water gases, which are mixed with the gases first formed.

2. The method, which consists in injecting with steam a heavy hydrocarbon into the lower and hottest portion of a mass of incandescent fuel in direct contact therewith, and injecting with steam a lighter hydrocarbon directly into the upper or cooler portion of the fuel, and mixing the gases so formed, substantially as specified.

3. The method which consists in blasting a body of fuel to incandescence, injecting tar or heavy hydrocarbon oil with steam directly into the body of incandescent fuel, to produce a gas containing methane and hydrogen and also water gas, injecting a lighter hydrocarbon with steam directly into the said body of fuel to produce ethylene and other bodies of high illuminating value with water gas, and conducting said gases through a regenerator, substantially as described.

4. The method of manufacturing gas which consists in blasting a mass of fuel to a state of incandescence, injecting heavy hydrocarbon with steam directly into the lower and hottest part of the mass of incandescent fuel, thereby decomposing the hydrocarbon into gas and carbon with water gas, whereof the gas contains large quantities of methane and hydrogen, injecting a lighter hydrocarbon with steam into the said mass of fuel to produce ethylene and other bodies of high illuminating value, conducting said gas through a highly heated regenerator charged with refractory material, such as firebrick and partly with iron, and injecting steam into said regenerator, whereby fuliginous matter carried into the regenerator by the escaping gas is converted into additional gas, substantially as described.

5. Apparatus for the manufacture or production of gas, comprising a gas generator constructed to contain incandescent fuel, a blast pipe for admitting air to said generator, injectors directed into said generator at different levels, and respectively connected with a source of steam supply and with independent sources of hydrocarbon supplies, and a regenerator, communicating at the top with the upper portion of the generator, and at the bottom with a gas outlet pipe, substantially as specified.

6. In the manufacture or production of gas, the combination with a gas generator, of a regenerator which communicates at the top with the generator, refractory material and iron arranged in the regenerator to form gas passages therethrough, and a tar well, having a division plate extending partially to the bottom thereof, and communicating upon one side of the said plate with the regenerator and at the opposite side with a gas outlet, together with means for injecting steam into said regenerator, substantially as specified,

Proposed Patent Legislation.

"W. C. L.," writing in a recent issue of *Iron Age*, says that the Government Patent Commission, which is now engaged in preparing recommendations for legislation in revision of the patent and trade mark laws, has arrived at an important determination of interest to inventors, manufacturers and others with regard to the priority of inventions, the authors of which have applied for protection abroad before filing their applications in this country. The commission will recommend that priority shall date from the filing of the foreign application, provided due diligence is shown in applying for the patent in the United States. Heretofore the laws have provided that the protection granted an inventor should date only from the time of the filing of his application in the Patent Office. It has sometimes happened that an inventor who has filed an application for a patent in a European country, and who has subsequently applied for protection for the same invention in the United States, has found himself confronted with a prior application for the same device. Investigation has shown that a shrewd and unscrupulous person has simply pirated the invention, drafting the specification directly from the foreign application. In such a case the American inventor would have been able to protect himself had the Patent Office taken cognizance of the date of his foreign application, which the Patent Commission proposes shall now be done.

It would be manifestly improper to permit an inventor to file his American application at a remote period after his foreign application and then secure contemporaneous protection, for he might thus extend the life of his patent far beyond the statutory period. The commission does not propose to permit this, and has, therefore, established a iimit of seven months which will be permitted to elapse after the filing of the foreign application, within which time patent must be applied for in the United States in order that priority may date from the filing of the foreign application.

After careful investigation the commission has practically decided that the caveat has no useful function in legitimate patent practice. It has frequently been invoked by inventors who have not clearly developed the principle of the devices upon which they have been experimenting, and by priority of date it has prevented other and more worthy persons from securing patents upon thoroughly worked out inventions. It is the opinion of the commission that no inventor is entitled to protection until he has proven the practicability of his device, and equally that no inventor who has fully developed an idea should be prohibited from patenting it because of the priority of a caveat filled by a person who perhaps never completed the invention, and who may have entirely abandoned it.

Another problem to which the commission is addressing itself with much energy relates to a general trademark law which shall avoid the objections to the present statutes which have recently been pointed out by the courts. In a recent decision of the United States Supreme Court it was held that the law for the general registry of trademarks is unconstitutional, and that Congress can only provide for registering trademarks for use in foreign, interstate or Indian commerce. The only trademark now issued by the Patent Office is specially required to be employed in foreign commerce. There are 33 States having trademark registry systems, and in order to secure the fullest protection manufacturers, proprietors and other are obliged to register their trademarks and pay their fees in all these States. In the States having no trademark systems no adequate protection can be secured. It is the hope of the commission to be able to draft a general law which will harmonize the diverse statutes of the States and reduce the cost of protection to a minimum. In this connection the following semi-official statement is made as to the intentions of the commission with regard to the extension of our patent and trademark laws in the newly acquired possessions of the United States :

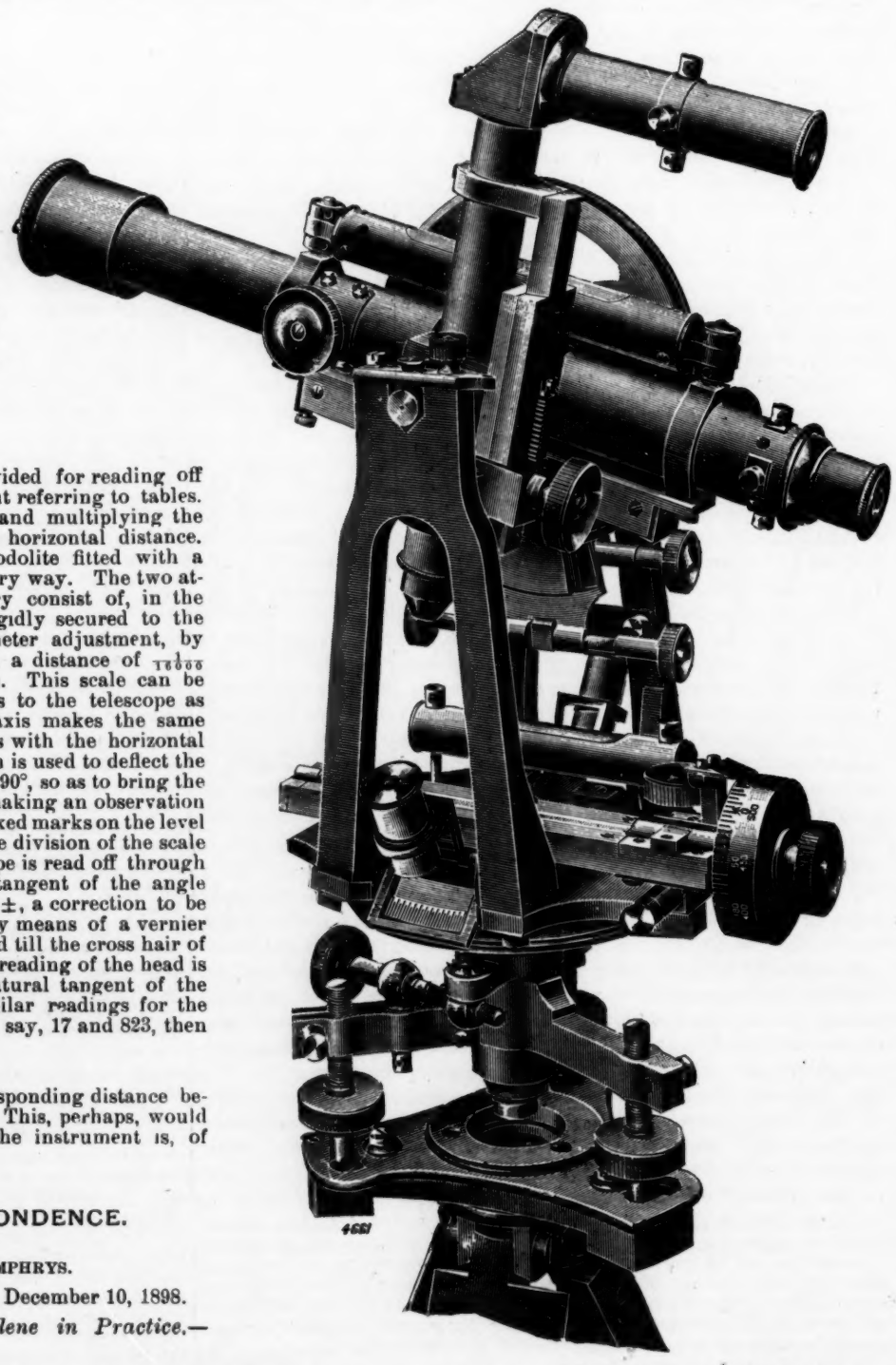
"The commission is now considering a proposition to include in its scope the consideration of these matters in the new territorial acquisitions of the United States. Whether it is authorized to do so is not quite determined, but if its duties are so extended it opens up a wide field of labor involving important complications, principally in the way of a conflict with the original schemes in the islands acquired. Hawaii has a patent law of its own, under which up to last year 138 patents had been issued. Under Spain's patent law, which has applied to all its colonies, there have been 19,000 patents issued since 1878 and up to last year. The Spanish patents are subject to annual taxes to keep them alive, and probably not over one-quarter of them are now in force. Those patents already granted, if now in force, it is contended, ought to be continued in force for the period for which issued, those terms not being uniform.

"On this point it is cited that Congress cannot impair the validity of contracts, these points being unquestionably good, considered as contracts. The issue is thus raised whether the United States will grant patents applying to the United States proper or to the whole country as so extended, though the latter is believed to be the more feasible course. As to Cuba, whose exact future status is not settled, the question is thus rendered the more puzzling, while the American citizens who go there will want the same protection as here. There doubtless will be an immense amount of sugar, agricultural, pumping and other machinery, implements, etc., taken in there, and protection for which will be sought."

The Bell-Elliott Tangent Reading Tacheometer.

We illustrate herewith a tacheometer theodolite, patented by Mr. G. J. Bell, of Carlisle, England, which is being placed on the market by Messrs. Elliot Brothers, of 101 and 102 St. Martin's Lane, London. In order to measure distances with this instrument a level staff is erected at the distant point, and the instrument having been carefully leveled, two readings are taken on points of the staff, say, 10 feet apart. Then if θ be the inclination of the line of sight to the horizontal in making the upper reading, and ϕ the inclination in making the lower reading, we have obviously the horizontal distance of the staff :

$$H = \frac{10}{\tan\theta - \tan\phi}.$$



In Mr. Bell's instrument a ready means is provided for reading off these tangents direct from the instrument, without referring to tables. Subtracting the two readings from each other, and multiplying the reciprocal of the result by 10, gives at once the horizontal distance. The instrument is essentially an ordinary theodolite fitted with a trough compass, which can be used in the ordinary way. The two attachments which fit it specially for tacheometry consist of, in the first place, a very accurately divided scale rigidly secured to the upper parallel plate, and fitted with a micrometer adjustment, by which it can be shifted with certainty through a distance of $\frac{1}{1000}$ inch up to $\frac{1}{10}$ inch in the direction of its length. This scale can be read through a microscope fixed at right angles to the telescope as shown, and moving with the same, so that its axis makes the same angle with the prime vertical as the latter does with the horizontal plane of the instrument. A total reflection prism is used to deflect the line of vision through the microscope through 90°, so as to bring the eyepiece into a convenient position for use. In making an observation the telescope is first aligned on the upper of the fixed marks on the level staff. The micrometer is then set to zero, and the division of the scale which is nearest to the cross wire of the microscope is read off through the latter. Say this was 19, then the natural tangent of the angle the line sight makes with the horizontal is 0.19 ±, a correction to be obtained from the micrometer head, which is by means of a vernier divided into 500 parts. This head is now rotated till the cross hair of the eyepiece exactly cuts the scale mark, and the reading of the head is then noted. Assume this to be 125. Then the natural tangent of the angle in question is 0.19125. On making similar readings for the lower mark on the staff the numbers might be, say, 17 and 823, then we should have

$$\text{Tan}\,\theta - \tan\phi = .01302.$$

The reciprocal of this is .76805, and the corresponding distance between staff and instrument would be 768.05 feet. This, perhaps, would be rather a long sight, and the accuracy of the instrument is, of course, the greater the nearer the staff.

SPECIAL ENGLISH CORRESPONDENCE.

COMMUNICATED BY NORTON H. HUMPHRYS.

SALISBURY, ENGLAND, December 10, 1898.

Slot Cookers.—Employers' Liability.—Acetylene in Practice.—Composition of Coal.

"Slot cookers and all about them" is the title of a series of interesting articles that have been contributed to the *Journal of Gas Lighting* by Mr. E. W. T. Richmond, the energetic principal of the firm of Richmond & Co., gas apparatus manufacturers of Warrington and London. A newsboy was once heard to call that his papers were "chock full of reading." In a similar way these articles may be said to be chock full of information, as they comprise a summary of the utterances of chairmen, directors or engineers of gas companies, as delivered at meetings of shareholders or of gas managers' associations, in reference to this particular subject, arranged in chronological order, from 1888 to the present day. The dry-as-dust character of statistics, necessarily including a great deal of figure matter, is characteristically relieved by appropriate Shaksperian quotations and by photographs representing rows of cottages in various towns that are fitted up with the prepayment system. It would be interesting, by the way, if someone would collate a list of the number of uses to which quotations from Shakspeare have been applied. Some of them have been trotted out in company that would have proved a surprise to their author had he lived to see. Mr. Richmond's firm, it may be added, believe in progressive principles. Where an over-cautious gas company hesitates about supplying stoves on hire, on the ground that there will be an annual bill for wear and tear, or renewal of stoves that may or may not swallow up all the profits, they are prepared to take the whole thing in hand at a fixed percentage per annum. And when the householders in a district prove to be deaf to the voice of the charmer from the gas office, and do not order stoves with the usual celerity, Richmond & Co. are prepared to invade that antiquated locality, with an army of qualified lady canvassers. Really, if Mr. Richmond has only health and strength, a "consummation devoutly to be wished" (the Shakspeare infection is already finding its way into your English letter), it will soon be bad times for the householder who prefers coal. He may perhaps get off by adopting a cooker, but he will do well for the sake of peace and quietness to put in a few gas fires also. The articles will in all probability be reproduced in pamphlet form; and may be recommended to the attention of all who desire information on this modern branch of gas consumption. The most striking feature in connection with the system is that in many districts it has opened up more new business in four years than was obtained during the previous forty. Still, it does not do to run away with the idea that the slot system is necessarily a universal success, and that all and every gas undertaking should at once adopt it, upon pain of being considered slow and behind the times. But it has given so good an account of itself that every gas engineer will do well to consider its applicability to his own particular circumstances. Its adoption means a substantial outlay, and the sinews of war should be provided before we begin to fight.

Recent enactments of the Government in respect to Employers'

Liability for Accidents to workmen in their employ, are another thorn in the none too comfortable pillow of the gas works manager. Already, by the Act of 1880 the employer was liable for injury due to his own oversight or negligence, but the Act of 1898 which came into operation last midsummer, renders the employer liable for every casualty, or injury, that may happen during working hours, whether the cause is under his control or not. In fact, so much care has been taken to make things safe for the workmen that the employers' side of the question has been to some extent overlooked. An employer of labor now needs a medical knowledge, sufficient to enable him to judge whether a man's state of health is such as to increase the risk of accident during his day's work, and the result cannot but be unfortunate to those subject to epileptic fits, partly incapacitated by age or infirmity, or by reason of physical or mental defect, more liable to accident than the average.

With regard to such work as employing a purifier, which, though attended with a certain amount of unpleasantness, is not actually injurious to health, one can easily imagine that a workman may come in the morning, I do not like to say suffering from the effects of a little over indulgence on the previous evening, but with nerves unstrung, or with his digestive organs in a bad condition, or otherwise in such a state that the least exciting cause, even such as would have no effect upon his colleagues, may be sufficient to completely upset the system and bring on an illness. This furnishes a plea for dragging the company into the law courts. The plaintiff's counsel draws a pitiable picture of the helpless state of his client, whose brain and muscles are his only capital, and then turns to the great and wealthy monopoly, rolling in ill-gotten riches, who would never miss an annual pension, and so on. Then follows the expert testimony, usually of a contradictory nature and to some extent unintelligible to the jury, but long enough, with the cross examinations, to thoroughly tire them out. The result is that when the verdict is discussed, the chief consideration is that the company can afford to pay, but the workman cannot afford to lose. The case is probably too complicated for them to decide definitely how far the man's constitution, and how far the conditions of labor, are concerned in the matter; and so, reversing the usual order of legal justice, the plaintiff, and not the defendant, gets the benefit of the doubt.

I do not believe in oppressing the working man, or in putting any obstacle whatever in the way of his securing any relief to which he may be justly entitled. But anything that encourages the man to go to law as against his employer is to be deprecated, as not likely to make things better for either party. Not only does it make matters hard for the elderly man, whose joints are not so supple, whose hearing and eyesight are not so keen as they used to be, to obtain employment, but it is a further inducement for companies to look to machinery as a substitute for manual labor. Already the handling of coal and also of coke is effected entirely by machinery, in large works. The filling and emptying of purifiers is not a more difficult matter. So the steam crane, the bucket elevator and the traveling bell, may in time entirely displace the man and the shovel.

A small gas company in Scotland, located at a place bearing the not over euphonious title of Cowdenbeath, has gone in for acetylene pure and simple, with none too satisfactory results. Previously to September last the supply, which appears to have been on a limited scale and mostly confined to shops, consisted of oil gas. The price charged was the respectable figure of 12s. 6d. per 1,000 cubic feet, and the quality was such as to lead to a strong disposition to try something new. From this it appears that the technical management of the Cowdenbeath ven ture is not of the highest order, seeing that the manufacture of gas from oil is if anything simpler than the ordinary coal gas process. And in justice to the new gas this point should be remembered, as a firm that could not give satisfaction with oil gas would not be the best suited for developing the capabilities of acetylene. However, the new illuminant appears to have given satisfaction until the settling time came round. A Scotchman once observed that he never had such an electric shock in his life as when the electric company presented their first bill, and a similar feeling seems to have been experienced when gas bills were presented, priced out after the rate of £5 per 1,000 cubic feet. A meeting of the consumers was held, and a deputation appointed to wait upon the gas company to protest against the £5 item, but with powers to agree to a figure of £2 10s. The fact that after a practical trial of acetylene the consumers were agreeable to a price fourfold of that previously paid for oil gas is certainly a strong point in its favor. The meeting was held, but with no satisfactory results, as it transpired that at £5 the acetylene business was a losing game, the actual cost to the directors being nearly £6 per 1,000 cubic feet, which is, we may remark in passing, about four times as much as the estimates advanced by advocates of the process. A second meeting of the consumers led to the passing of a resolution to discontinue the use of acetylene, and the gas company were accordingly requested to read the meters and close the accounts. The gas company in despair promptly returned to oil, but the oil gas did not at all agree with the special burners, and the light furnished was of a miserable description. So here is a first rate opportunity for anyone who can show the directors how to supply acetylene at £2 10s. per 1,000 cubic feet and make a fair profit thereby.

A very interesting and suggestive paper on some of the chemical properties of Scotch coal was read before the Scottish section of the Society of Chemical Industry, a few weeks ago. It is remarkable that chemists are able to tell us so little about the composition of coal. It can be decomposed by combustion, or by destructive distillation. In the first case, we can examine the products and find out the percentage of carbon, hydrogen and other elements present in the sample. We can also determine the quantity of heat given out, which is usually the most important factor as regards the commercial value. The products of fractional distillation also furnish some indication as to the elements present in the sample, and roughly as to the way in which they are combined. But beyond this, science has as yet failed to penetrate. The methods of solution and precipitation, by which many chemical compounds can be analyzed, are of no use here. The authors are to be commended for their boldness in attacking a difficult problem. Incidentally they refer to the threatened nitrogen famine, to which I alluded some months ago, and point out that, so far from the nitrogen contained in coal being a matter of no moment, the annual output of coal which is taken at over 200,000,000 of tons per annum in the United Kingdom only, and not far short of that quantity in the United States, contains a great deal more than the world's requirement of nitrogen. At a low estimate it would be capable of yielding the equivalent of 4,000,000 tons of sulphate of ammonia. They give a large number of ultimate analyses of various samples and point out that the chemical composition thus indicated is of no value whatever in determining the practical value of a coal. For example, two coals identical in ultimate composition, had been shown to give entirely different results when ignited in absence of air. One yielded a good coke, the other a pulverulent residue. The authors endeavored to arrive at a "coking index" by mixing their samples before ignition with as much clean white sand as would leave a coherent coke in the crucible. They also heated samples of coal to a temperature of 300° C. for three hours in a current of dry carbon dioxide gas; they endeavored to extract resinous matter by treatment with caustic potash, and to oxidize the coal by treatment with nitric acid. The effect of the treatment last named was to produce a lustrous, black and very brittle substance, insoluble in water, but very easily soluble in alkaline liquids; and from the solution thus obtained, a bulky brown flocculent precipitate was thrown down by acids which was insoluble in solutions of acids and mineral salts, but to some extent soluble in pure water. These acid bodies contained about 30 per cent. of oxygen, but otherwise did not differ greatly in ultimate composition from the original sample.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

AT the annual meeting of the United Gas and Electric Company, of Dover, N. H., the officers chosen were: Directors, Albert Wallace, George E. Wallace, George E. Macomber, Jno. Kivel, Chas. Davis, Jno. F. Lang and H. L. Shepherd; President, Albert Walllace; Treasurer and Manager, H. L. Shepherd; Clerk, Leslie P. Snow.

THE proprietors of the Haverhill (Mass.) Gas Company have determined to make another reduction in the selling rates. The gross price is put at $1.10 per 1,000 cubic feet, prompt payment (within 10 days) entitling the consumer to a rebate of 10 cents per 1,000.

THE Southport and Fairfield districts of Connecticut will be supplied with gas next year.

THERE is considerable agitation just now in Easton, Pa., over the rate charged by the local Gas Company. There seems to be some fair reason for the objection in that the average price is not less than $1.75.

THE United Gas Improvement Company has been awarded the contract for the generator apparatus in the new gas plant that is to be constructed at Torrington, Conn. The Improvement Company will install two sets of its standard, double superheater Lowe water gas apparatus, with a daily capacity of about 500,000 cubic feet.

THE congregation of the Blackwood Methodist Episcopal Church, of Camden county, N. J., are mourning the loss of their house of meeting. It was destroyed early this month by the explosion of an acetylene gas machine, that had been put in to furnish light for the structure.

AT a meeting of the voters of the town of Revere, Mass., the following result was reached: Mr. S. A. Segee presented an "Article, to see if the town will appoint a committee to examine into the advisability of the town putting in its own gas pipe system and purchasing gas from the New England Gas and Coke Company, and controlling the distribution of the same to the inhabitants of the town." On motion of

Mr. Segee it was voted that the Moderator (Mr. Nevins) appoint a committee of seven to investigate the subjects named in the Article, the committee to report at the next session of the town meeting. The committee was further instructed to appear before the Board of Gas and Electric Light Commissioners and oppose the issuance of stock by any corporation at present organized to furnish gas for Revere. The committee named was: Samuel A. Segee, Arthur R. Champlin, Jno. B. Seward, Jno. F. Ranahan, William Albrecht, Walter A. Haynes and William T. Brennan.

On the 15th inst. the authorities of Mount Clemens, Mich., at the invitation of the proprietors of the Mount Clemens Gas Company, inspected the plant of the latter, which was declared to be in every respect up to the pledges made by its projectors when they were before the Council on petition for a franchise. The inspection was followed by a well arranged, well-served luncheon, which refection was enjoyed in the handsome offices of the Company on Macomb street. The Company, we are told, has 300 consumers on its rolls.

The works of the Jenkintown and Cheltenham (Pa.) Gas Company are almost completed.

General Calvin Fitch Bissell, for a long period connected with the Le Roy (N. Y.) Gas Light Company, died at his home in Le Roy, the evening of the 11th inst. Deceased was born in Greenfield, Mass., March 9, 1818. In 1838 he removed to Le Roy, where he studied law, Judge Putnam, of Attica, N. Y., being his mentor. In 1869 he was appointed Quartermaster General, with the rank of Brigadier General, on the staff of Governor Hoffman. He is survived by his second wife and two sons.

The proprietors of the Cicero Gas Company, of Oak Park, Ills., have announced that, on and after January 1, 1899, the selling rates will be: For an illuminating use, $1.25 per 1,000 cubic feet; for a supply on fuel account, $1 per $1,000. This amounts to a concession of 25 cents per 1,000 all round.

We understand that the plant of the Ithaca (N. Y.) Gas Light Company will be rebuilt next spring.

The Seattle (Wash.) Gas and Electric Company will perform a good part of the public lighting of that place hereafter, using Welsbach lamps as the agents. "C. R. C.," writing from Seattle, under date of the 14th inst. in reference to this matter, says:

To the Editors American Gas Light Journal: You will probably be interested in knowing that the fittest has survived. After two years of bidding, without result, the Seattle Gas and Electric Company succeeded in getting a part of the city lighting with Welsbach lamps. The lamps will be mounted in No. 51 Miner globes, set on ornamental brackets fastened to telegraph poles. The lamps will be placed at a height of 12 feet from the ground.

Mr. C. A. Schwarm, of the South Side Gas Company, Pittsburg, Pa., writing to the Journal under date of the 20th inst., says:

To the Editors American Gas Light Journal: I forward herewith an item that may be of interest to some of the readers of your valued paper. What proved to be a most remarkable accident happened in Pittsburg, Pa., at some time previous to its tracing or discovery, about December 14th. For almost one week the residents of South 11th street, close to the river, in the district bounded by Muriel, Bingham, 10th and 11th streets, complained of a shortage in the supply of the Monongahela Water Company. Immediately on receipt of complaints the Water Company instituted an investigation of the gates, lines and services in the district with the result, after a week's search, of unearthing a wonderful state of affairs underground. The soil in the street was of a very soft, loamy nature, and eight gas and water lines, belonging to various companies, and of sizes ranging from 2 inches to 30 inches in diameter, were laid through it. A workman of the Water Company was told to dig a hole about the center of the street, and after digging through the frost line, which was say 22 inches in depth, the digger encountered a cavern. Work was diligently gone on with other test pits, each of which ended in a cavern, the depth of which was seemingly limitless. Explorers were lowered into the cavern, and their investigation developed the fact that the cavernous opening or rift embraced a space ranging from 10 to 20 feet in width, by 120 feet in length, and from 8 to 10 feet in depth. It was not a difficult matter after descending into the hole to discover the cause of the trouble. A 4-inch water main, having been undermined by a leaky service line, sagged and broke square off, allowing the whole supply of water to wash the soil into a 15-inch sewer line, which had been placed in the street with the expectation of putting in a drop at some future date, and which had not been closed properly. The sewer and water lines, being close together at a low point in the street, the rush of water washed all the soil to the river, the leaking water following a like course, instead of coming to the surface as ordinarily would be the case. The soil having all been washed away, the gas lines—both natural and artificial—were hanging unsupported, and without any foundation whatever. The covering of the cavern was formed entirely by the sand, gravel and paving stones held together by the frost. As this was a very serious looking affair no time was lost by the various companies in strengthening, blocking-up and cutting-off the lines through the cavern, as the covering was liable to fall at any time, thus breaking the gas lines and probably causing a serious explosion.

The proprietors of the Fresno (Cal.) Gas and Electric Light Company have given notice that the shareholders have endorsed the proposition to bond the property in the sum of $50,000. The bonds are to live for 20 years, and are to bear interest at the rate of 6 per cent. per annum.

A concern, operating under the title of the Standard Gas Company, of America, with headquarters in Philadelphia, has submitted a proposition to the authorities of Alexandria, Va.—the gas works there are operated on municipal account—to put coal gas into the holders at the rate of 60 cents per 1,000 cubic feet, the supplying concern to be permitted to use the generating plant owned by the city. It is further stipulated that the agreement is to run for 25 years. Our informant (and with seeming great propriety) adds that the proposal was "coldly received by the Council, who ordered it referred to the Committee on Light."

The authorities of Philadelphia are somewhat concerned over the appointment of an official gas meter inspector. The indications are that the place will fall to Mr. N. Wiley Thomas, who is connected with Girard College in an educational capacity.

The Pittsburg (Pa.) *Press*, of the 14th inst., says that the gas and electric light companies of Pittsburg and Allegheny will by January 1st be combined under the charter now held by the Philadelphia Company. The deal has been pending for some months and is about completed. The preliminary papers have been signed, and only a few minor details remain to be settled. The terms of the consolidation will be made known in a few days. The deal, which involves the payment of $9,000,000, was carried through by the capitalists who control the Consolidated Gas Company, and the new Company will have a capital of $36,000,000. Some of those interested in the syndicate are Messrs. C. L. Magee, William Flinn, J. H. Reed, Jno. R. McGinley, M. K. McMullin and George Westinghouse. The deal embraces the Philadelphia Gas Company, the Consolidated Gas Company and the Allegheny County Electric Light Company, and under the leases of the Philadelphia Company, the Allegheny Heating Company, Chartiers Valley Gas Company and Pennsylvania Natural Gas Company, will also be included."

It is now said that Contractor C. Geddes will not be able to complete his contract, under which he agreed to supply artificial fuel gas manufactured a la Bidelman, to the city authorities of Toledo, O., at the wholesale rate of 18 cents per 1,000 cubic feet. This manufactured gas was to help out the natural gas distributed on municipal account by the authorities of Toledo, the natural gas flow having so decreased that the city was unable to meet all the demands for it. Why it is that Geddes has failed is not made plain.

The latest hint made in connection with "absorptions" of gas properties comes from Wilmington, Del., by way of the columns of the Wilmington *News*, which said that, on the 11th inst., "local financial circles were filled with rumors of deals in which the sale of the Wilmington City Electric Company and the attempt to purchase the Wilmington Coal Gas Company figured most. * * * While no definite offer has been made for the control of the Wilmington Coal Gas Company, there have been, as stated, a number of inquiries made in reference to the stock, and it is believed that the inquiries come from the United Gas Improvement Company, of Philadelphia. It is said that the Company would be willing to purchase the controlling interest at any time, but those who own the controlling interest will not sell unless all of the stockholders are taken care of." The suggested bid price for the stock is about 250 per cent. It is, from our light on the subject, not likely that Mr. Betts and his associates are disposed to consider

(*Continued on page 937.*)

(*Continued from page* 336.)

seriously a proposition to part just now with control in the Company that they have so well and conservatively managed for many years.

A CORRESPONDENT forwards the following, from Springfield, Mass., under date of the 17th inst.: "The taking over of the gas and electric lighting plants of the Westfield (Mass.) Gas Company, for operation on municipal account, has advanced to the point where the commissioners to appraise the values of the properties have been named. The commissioners (they were named by Judge Knowlton) are: James R. Dunbar, of Brookline—he is also Chairman; R. J. Monks, of Boston; Jas. C. Chalmers, of Adams. Should the findings of the commission be unsatisfactory to either the Company or to the town the dissatisfied party has the right to appeal to the Supreme Court of the State for a revision; but the dictum of that Court shall be considered binding."

THE gas rate at Kingston, N. Y., has been put at $2 per 1,000 gross, with 10 per cent. off for prompt payment—within 10 days.

THE authorities of Richmond, Va., are considering an ordinance proposing to "establish not less than 6 nor more than 18 sub treasuries at various points in the city where water and gas bills may be paid."

THE following letter explains itself—it appeared in the issue of the Brooklyn (N. Y.) *Daily Times*, dated the 17th inst.:

To the Editor of the *Brooklyn Times*—Sir: My attention has just been called to an article upon the gasholder accident at East 21st street, New York, published upon third page, third column, of your issue of Wednesday evening, the 14th inst., which concludes with the following statement:

"Members of the firm owning the Continental Iron Works of Greenpoint are congratulating themselves to-day over the fact that the award of the contract for the construction of the tanks for the Consolidated Gas Company was not given to them."

This statement is not true, and, uncontradicted, might carry the inference that we are gloating over the misfortunes of our neighbors in Brooklyn and friends in Manhattan, against which we earnestly protest. In lieu of congratulations we deeply sympathize with all concerned with the contract in question, or who are in any way affected by the appalling catastrophe.

Kindly give this statement the same publicity which obtained with the other, and sincerely oblige, yours very truly,

THE CONTINENTAL IRON WORKS,
THOS. FITCH ROWLAND, President.

Brooklyn, Dec. 16, 1898.

The Market for Gas Securities.

Strength was the prevailing characteristic of the gas share market the past week, Consolidated selling up to 197 and down to 193. The rate at 2 P.M. to-day (Friday) for it was 193 bid, 195 asked. Sales had been made at 194¾. Mutual is dull, at 300 to 305; but not much stock could be bought at the asking price. New Amsterdam common is very strong, at 33½ to 34 this afternoon. The Berrian's Island promoters are making much display—let them alone and they'll come home.

The real feature of the market, though, is Brooklyn Union, which sold to-day at 140. Investors in local gas shares should watch the vagaries of Edison Electric Illuminating Company closely, for on the ultimate disposal of that property depends the time when the "grand" consolidation of the artificial lighting interests of Manhattan will be made. Bay State sold this afternoon at 7⅞; Consolidated, of Baltimore, is 69¾ to 70½; Washington, D.C., 250 to 255; Peoples, of Chicago, 109¼ to 109½; and Cincinnati, ex all rights, is 199 to 200. The United Gas Improvement Company's regular quarterly dividend of 2 per cent., is payable January 14th. The shares in that Company are 252 bid.

Gas Stocks.

Quotations by Frederic B. Cochran & Co., Brokers and Dealers in Gas Stocks.

20 AND 22 BROAD STREET, NEW YORK CITY.

Dec. 26.

☞ All communications will receive particular attention

☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$37,730,000	100	194½	195½
Central Union, Bonds, 5's.	3,000,000	1,000	105½	106½
Equitable Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	114	.
Metropolitan Bonds	658,000	.	108	112
Mutual	3,500,000	100	300	305
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	.	..	
New Amsterdam Gas Co.	13,000,000	100	33½	34
Preferred	10,000,000	100	68	69
Bonds, 5's	11,000,000	1,000	102	102½
Northern Union, Bonds, 5's.	1,250,000	1,000	94½	95½
New York and East River..				
Bonds 1st 5's	3,500,000	1,000	111	113
" 1st Con. 5's	1,500,000		107½	108½
Richmond Co., S. I.	348,650	50	70	..
" Bonds	100,000	1,000	..	..
Standard	5,000,000	100	139	142
Preferred	5,000,000	100	157	161
Bonds, 1st Mortgage, 5's	1,500,000	1,000	112	114
Yonkers	299,65	500	130	.
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	139½	140
" " Bonds (5's)	15 000,000	1,000	115	116
Bay State	50,000,000	50	7⅜	7⅝
" Income Bonds	2,000,000	1,000	..	75
Binghamton Gas Works..	450,000	100	..	..
" 1st Mtg. 5's	450,000	1,000	..	..
Boston United Gas Co.—				
1s Series S. F. Trust	7,000,000	1,000	92	..
2d " " "	3,000,000	1,000	..	80
Buffalo City Gas Co.	5,500,000	100	16	16½
" " Bonds, 5's	5,250,000	1,000	93	93½
entral, San Francisco	2,000,000	..	105	..
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	104¼
Columbus	1,144,700	100	89	91
1st Mortgage	1,207,000	1,000	101	103½
Consumers, Jersey City	2,000,000	100	80	..
" Bonds	600,090	1,000	102	104
Cincinnati G. & C. Co.	8,500,000	100	199	200
Consumers, Toronto	1,600,000	50	184½	187
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000		..
Consolidated, Baltimore	11,000,000	100	69	70
Mortgage, 6's	3,600,000	..	107	107½
Chesapeake, 1st 6's.	1,000,000	..	..	..
Equitable, 1st 6's.	910,000	..	..	..
Consolidated, 1st 5's	1,490 000		..	..
Consolidated Gas Co. of N.J.	1,000,000	100	16	21
" Con. Mtg. 5's	380,000	1,000	75	80
Consolidated G. & E. Co.'s., Little Falls, N.Y.	90,000	100	..	100
Bonds	75,000	..	..	100
Detroit City Gas Co	4,560,000	50	65	65½
" Prior Lien 5's	4,546,000	1,000	94¼	94½
Detroit Gas Co., 5's	423,000	1,000	..	..
" Inc. 5's	31,000	100	..	..
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Fort Wayne	2,000,000	..	75	80
" Bonds	2,000,000	..	88	
Grand Rapids Gas Lt. Co.	1,000,000	50	..	..
" 1st Mtg. 5's	1,125,000	1,000	..	.
Hartford	750,000	25	..	145
Indianapolis	2,000,000	..	115	125
" Bonds, 6's	2 650,000	..	106	107
Jackson Gas Co	250,000	50	..	..
" 1st Mtg. 5's	250,000	1,000	..	..
Jersey City	750,000	20	210	..
Lafayette Gas Co., Ind.	1,000,000	100	78	83
Bonds	1,000,000	1,000	90	91
Louisville	2,570,000	50	..	..
Laclede, St. Louis	7,500,000	100	52	53
Preferred	2,500,000	100	95	96
Bonds	10,000,000	1,000	105½	106
Madison Gas & Elec. Co.	400,000	100	..	..
" 1st Mtg. 6's	350,000	1,000	..	..
Montreal, Canada	2,000,000	100	200	..
Newark, N. J., Gas Co	1,000,000	..	200	220
Bonds, 6's	4,000,000	..	128	130x
New Haven	1,000,000	25	252	..
Nashville Gas Lt. Co.	1,000,000	50	110	..
Oakland, Cal.	2,000,000	..	53½	55
" Bonds	750,000	..	..	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	109¼	109½
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,00	1,000	..	108
2d "	2,500,000	1,000	104	105
Peoples, Jersey City	500,000	50	240	250
Rochester Gas & Elec. Co.	2,150,000	50	52	..
Preferred	2,150,000	50	105	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	10,000,000	100	88½	89
St. Paul Gas Light Co	1,500,000	100	50	52
1st Mortgage 6's	650,000	1,000	82	85
Extension, 6's	600,000	1,000	..	..
General Mortgage, 5's	2,428,000	1,000	80	82
St. Joseph Gas Co	1,000,000	100	..	..
" 1st Mtg. 5's	750,000	1,000	..	..
Syracuse, N. Y.	1,750,000	100	199¼	201½
Bonds	1,612 000	1,000	85	89
Washington, D. C	2,600,000	20	250	255
First mortgage 6's	600,000	..	..	..
Western, Milwaukee	4,000,000	100	85½	86
Bonds, 5's	3,830,500	.	101¾	102½
Wilmington, Del.	550,000		204	206

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DIVIDEND NOTICE.

OFFICE OF THE UNITED GAS IMPROVEMENT CO., DREXEL BUILDING, PHILA., PA., Dec. 21, 1898.

The Directors have this day declared a quarterly dividend of 2 per cent. (one dollar per share), payable on Jan. 14, 1899, to stockholders of record at the close of business Dec. 31, 1898. Checks will be mailed.

1229-3 EDWARD C. LEE, Treasurer.

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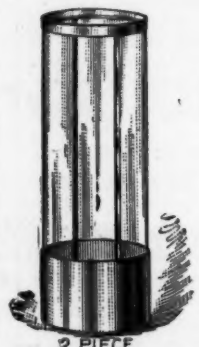

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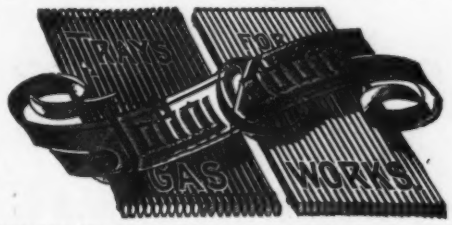

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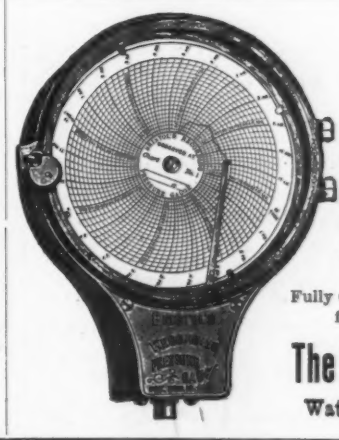

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—OF THE—

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MR. E. H. YORKE, NEW HAVEN, CONN., Dec. 1, 1898.

Dear Sir:—I am in receipt of a copy of "Excerpts from the Decisions of the Board of Gas Commissioners," which is a handy compilation in book form of extracts from the most recent decisions of the Gas Commission of Massachusetts.

I note that most of these extracts are broad and safe-guiding precepts, which apply with equal force to one Company as to another. The 13 years' existence of the Board of Gas Commissioners with its unusual opportunities for acquiring information, have justly made it a high and safe authority in all matters pertaining to the management, obligations, and rights of Gas Companies. Your little book will serve as a valuable reference library in settling legal complications which often arise between a Gas Company and its customers.

Yours truly, (Signed) F. C. SHERMAN, Superintendent.

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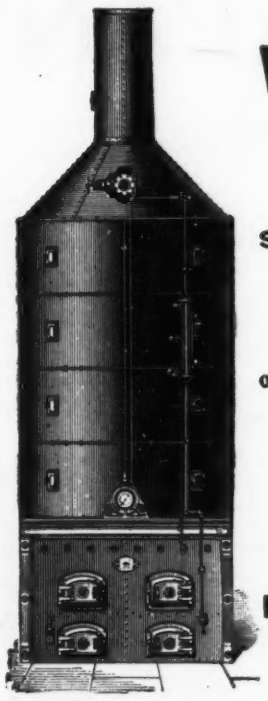

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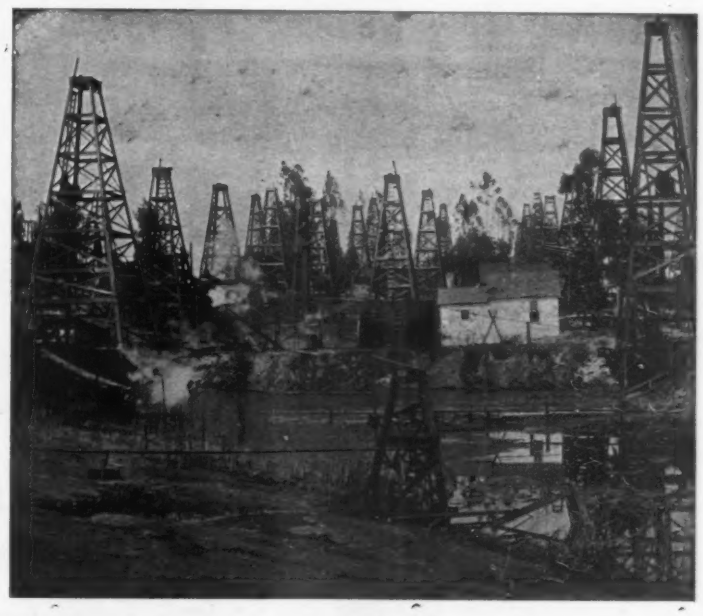

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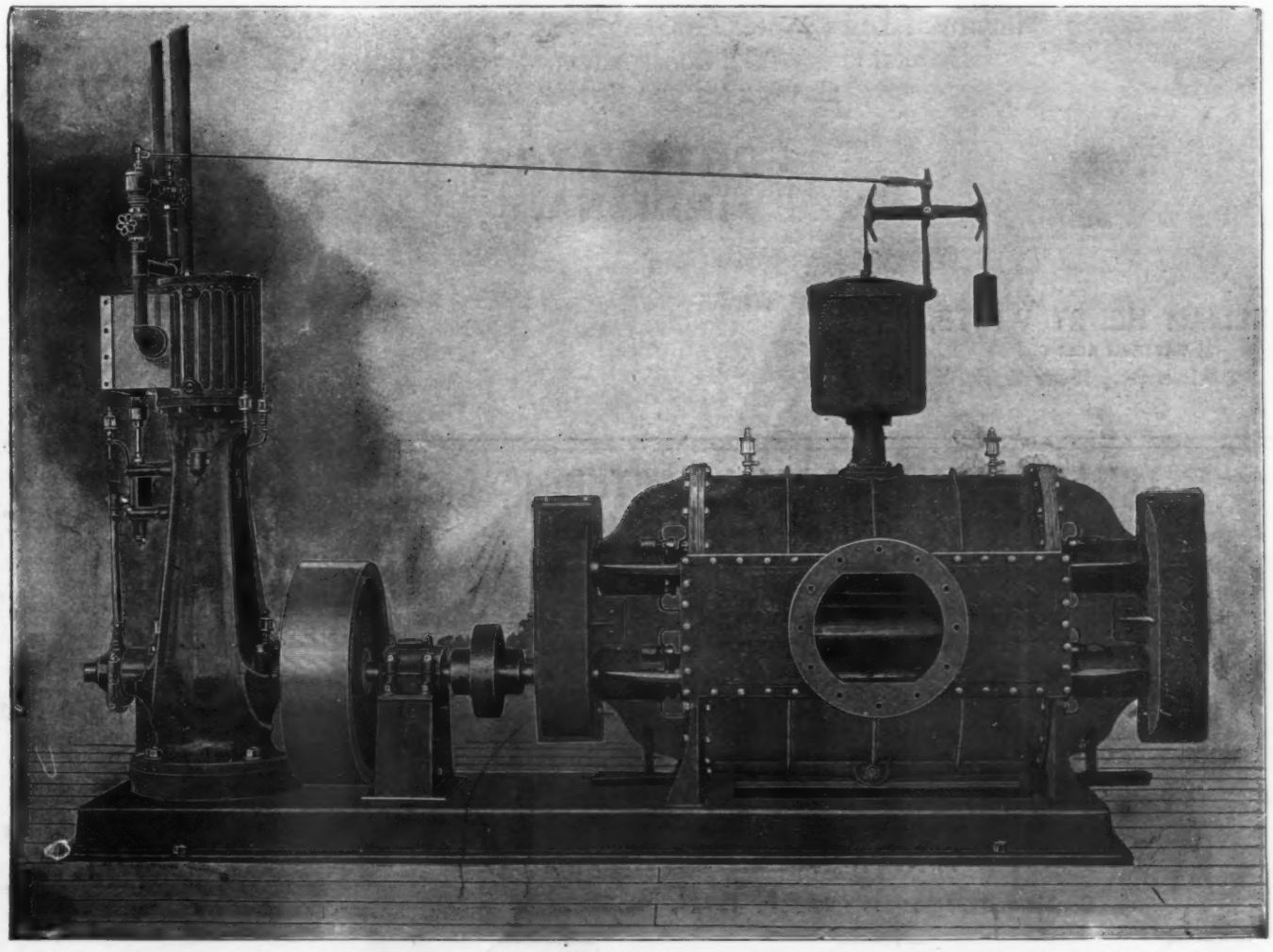

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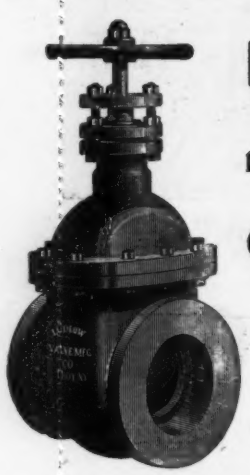

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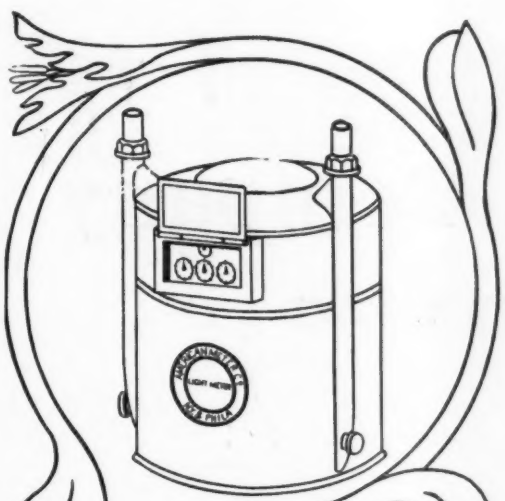

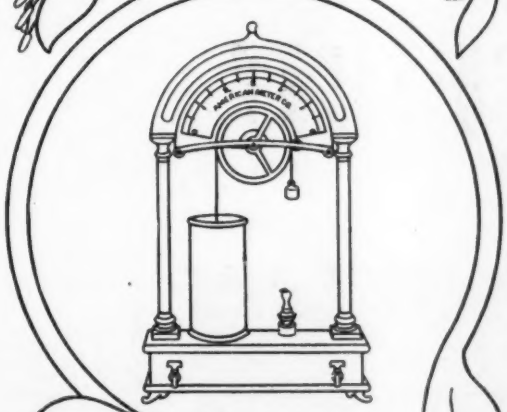

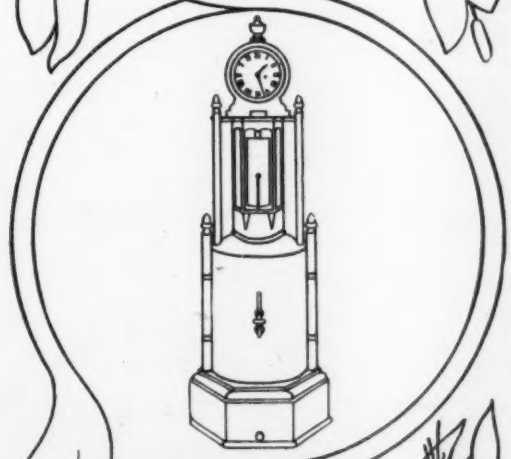

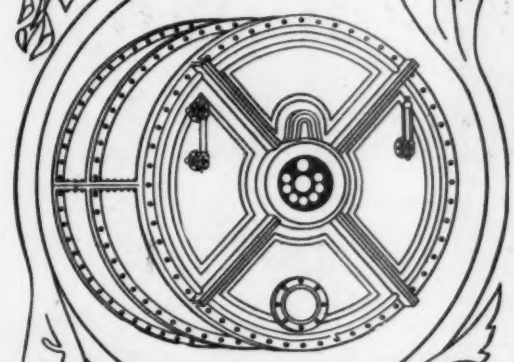

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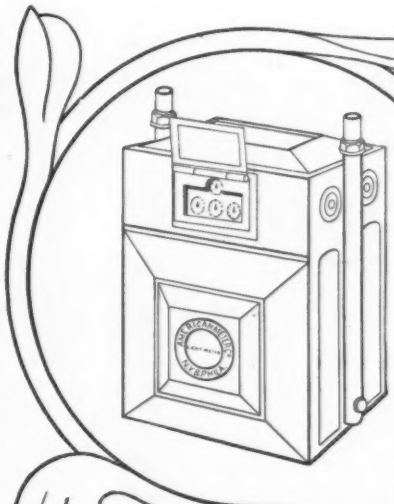
PUBLIC LIGHTING TABLE.

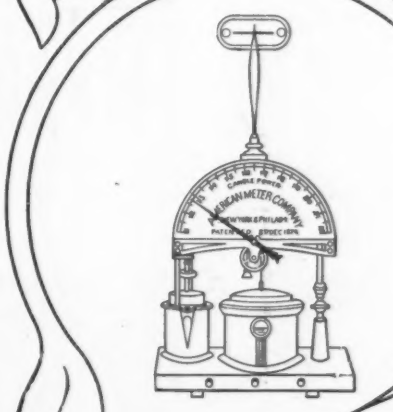
JANUARY, 1899.

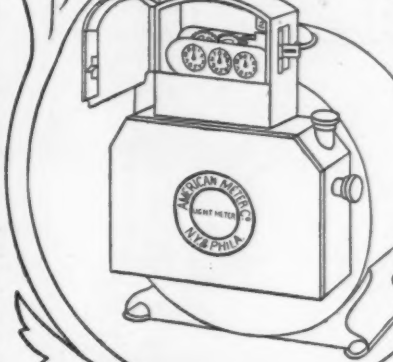
Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Table No. 1. Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Table No. 2. Extinguish.
				P.M.	A.M.
Sun.	1	5.20 PM	10.20 PM	4.30	6.30
Mon.	2	5.20	11.20	4.30	6.30
Tue.	3	5.20	12.20 AM	4.30	6.30
Wed.	4	5.20 LQ	1.30	4.30	6.30
Thu.	5	5.20	2.30	4.30	6.30
Fri.	6	5.20	3.40	4.30	6.30
Sat.	7	5.20	4.50	4.30	6.30
Sun.	8	5.20	6.20	4.40	6.30
Mon.	9	5.20	6.20	4.40	6.30
Tue.	10	5.20	6.20	4.40	6.30
Wed.	11	5.20 NM	6.20	4.40	6.30
Thu.	12	5.20	6.20	4.40	6.30
Fri.	13	5.20	6.20	4.40	6.30
Sat.	14	5.20	6.20	4.40	6.30
Sun.	15	5.30	6.20	4.50	6.25
Mon.	16	10.00	6.20	4.50	6.25
Tue.	17	11.10	6.20	4.50	6.25
Wed.	18	12.10 AM	6.20	4.50	6.25
Thu.	19	1.20	6.20	4.50	6.25
Fri.	20	2.20	6.20	4.50	6.25
Sat.	21	3.20	6.20	4.50	6.25
Sun.	22	4.00	6.20	5.00	6.25
Mon.	23	4.50	6.20	5.00	6.25
Tue.	24	5.20	6.20	5.00	6.25
Wed.	25	No L.	No L.	5.00	6.25
Thu.	26	No L. FM	No L.	5.00	6.25
Fri.	27	No L.	No L.	5.00	6.25
Sat.	28	5.40 PM	8.20 PM	5.00	6.25
Sun.	29	5.50	9.20	5.05	6.15
Mon.	30	5.50	10.20	5.05	6.15
Tue.	31	5.50	11.20	5.05	6.15

TOTAL HOURS LIGHTING DURING 1899.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January	215.40	January	423.20
February	184.40	February	355.25
March	187.40	March	355.35
April	166.50	April	298.50
May	158.00	May	264.50
June	140.50	June	234.25
July	150.30	July	243.45
August	168.30	August	280.25
September	179.50	September	321.15
October	213.20	October	374.30
November	217.00	November	401.40
December	238.10	December	433.45
Total, yr.	2221.00	Total, yr.	3987.45







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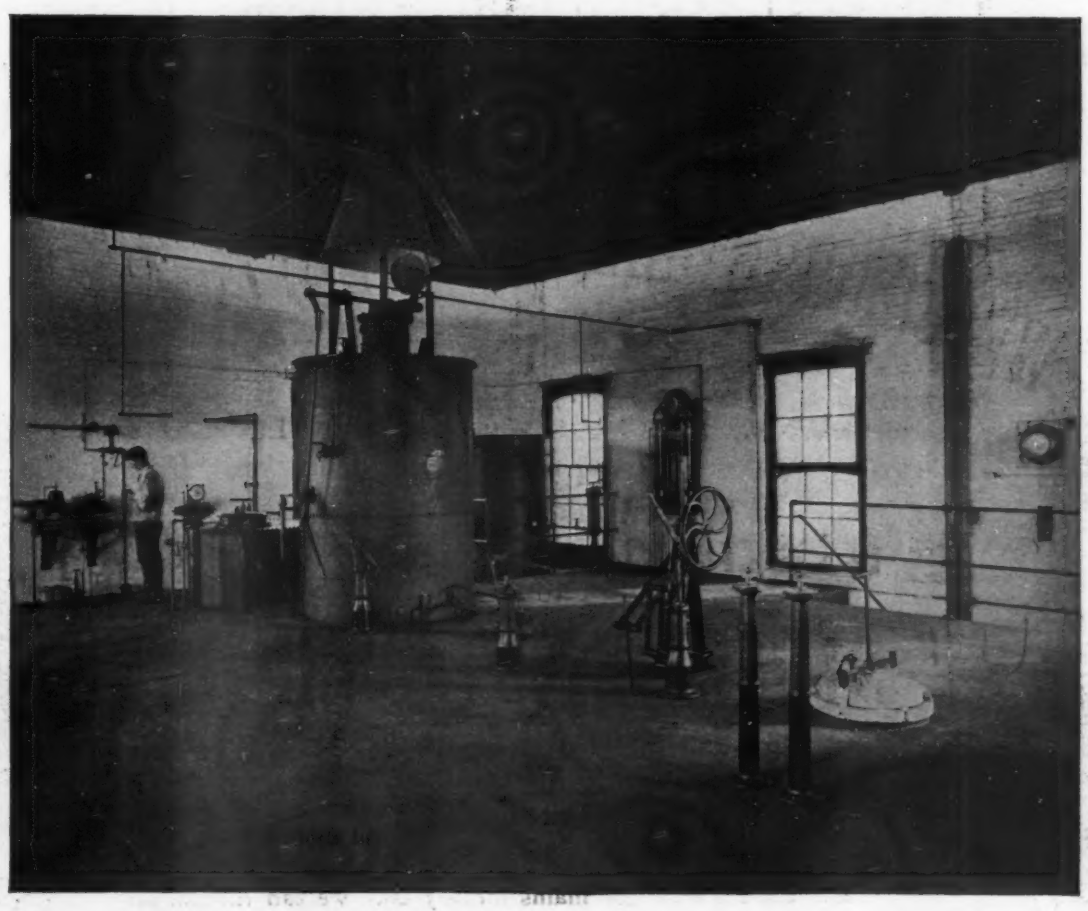

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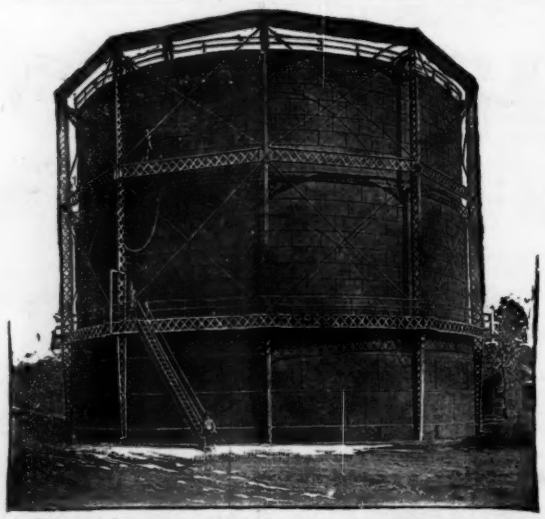

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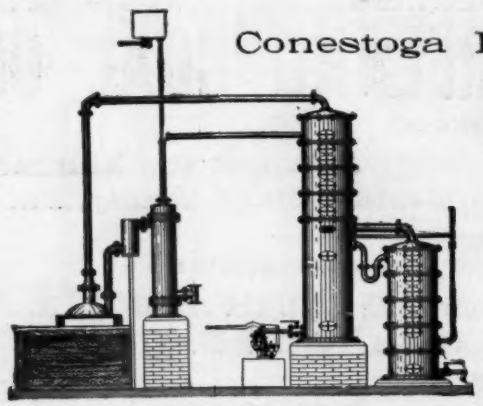

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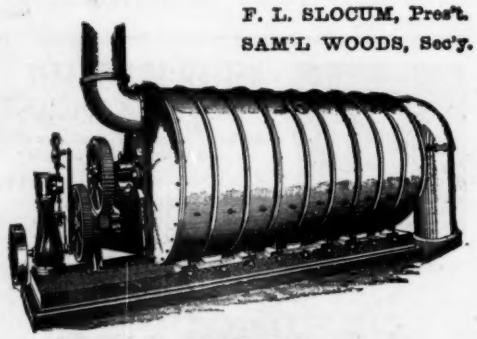

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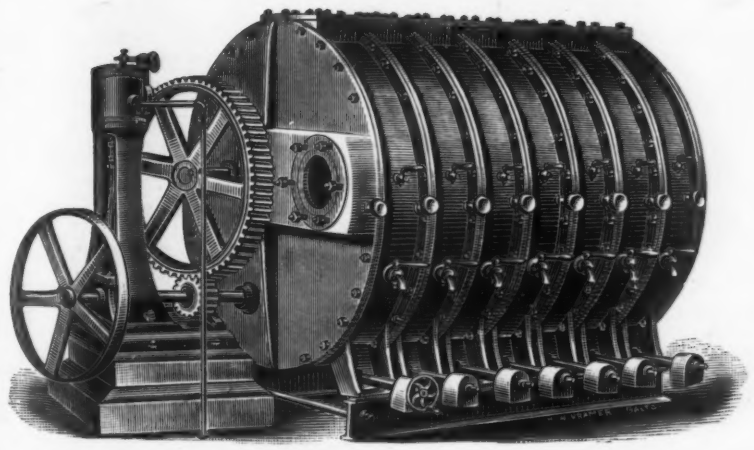

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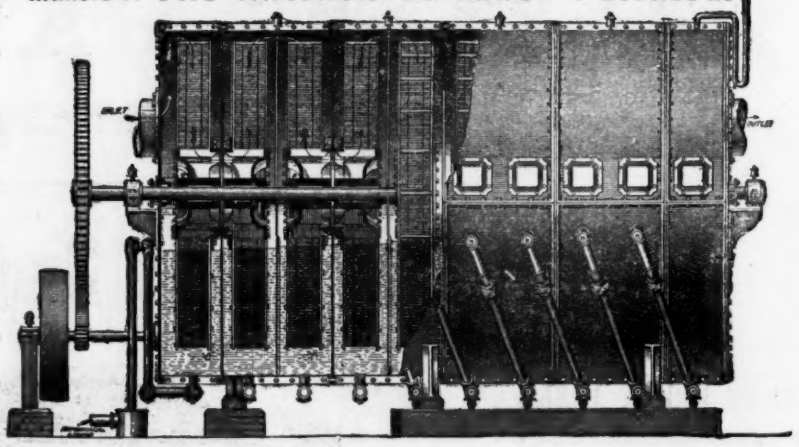

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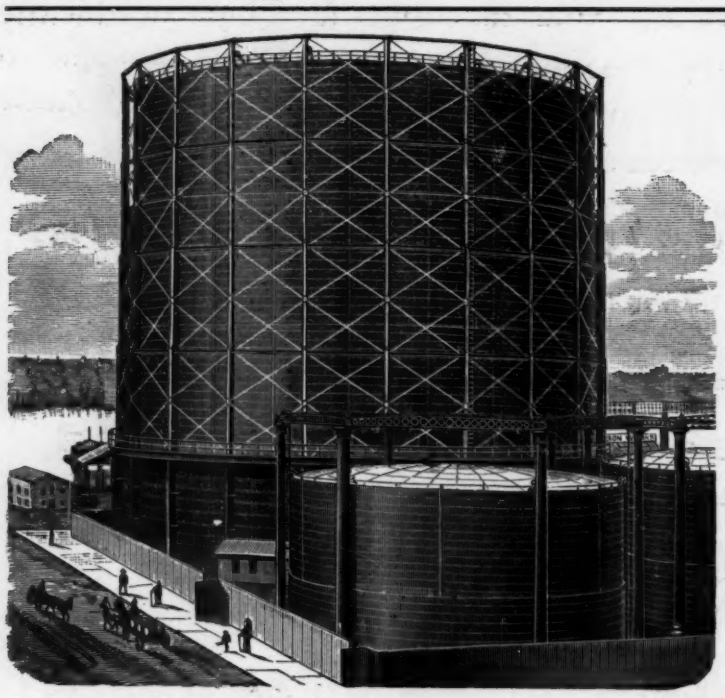

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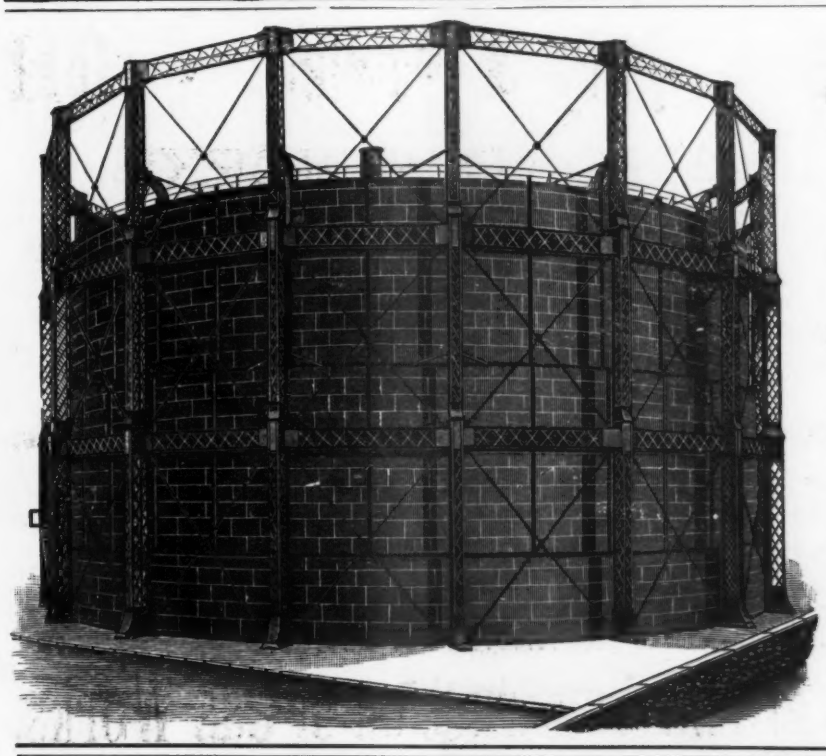

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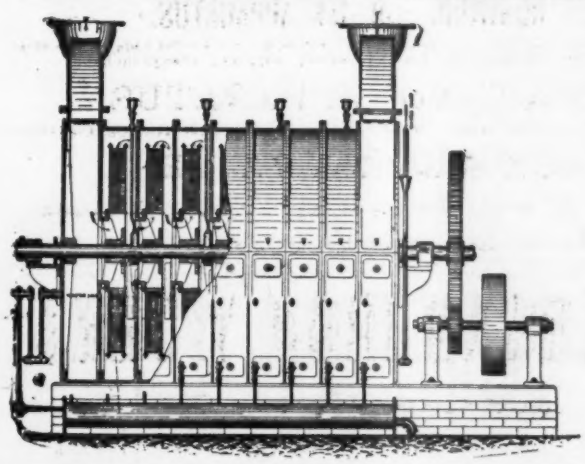

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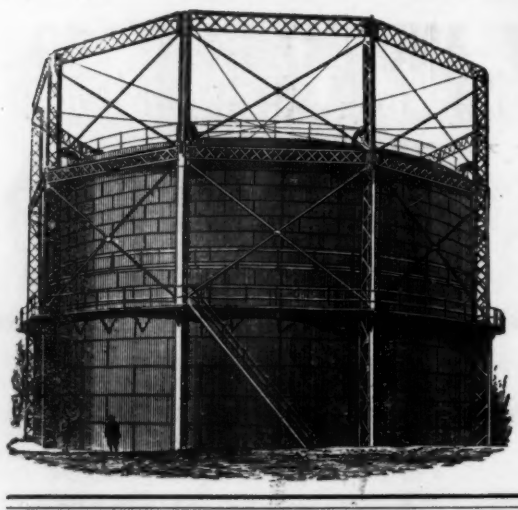

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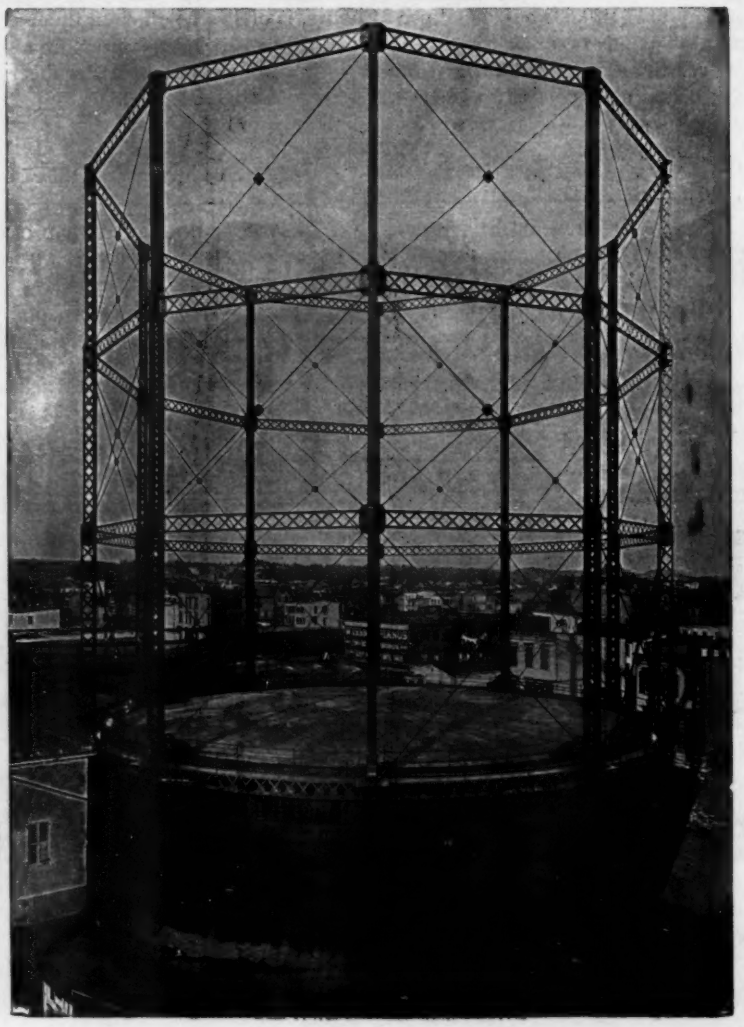

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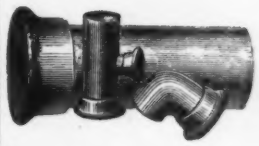

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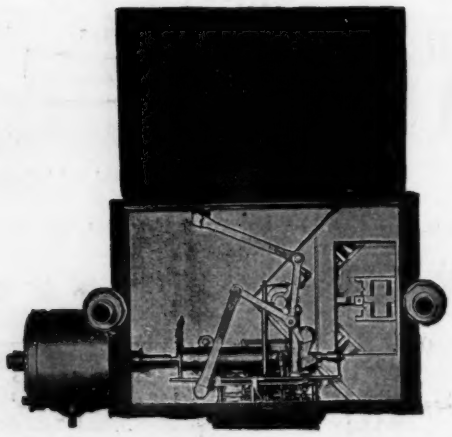

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